STRY

WORLD CROPS

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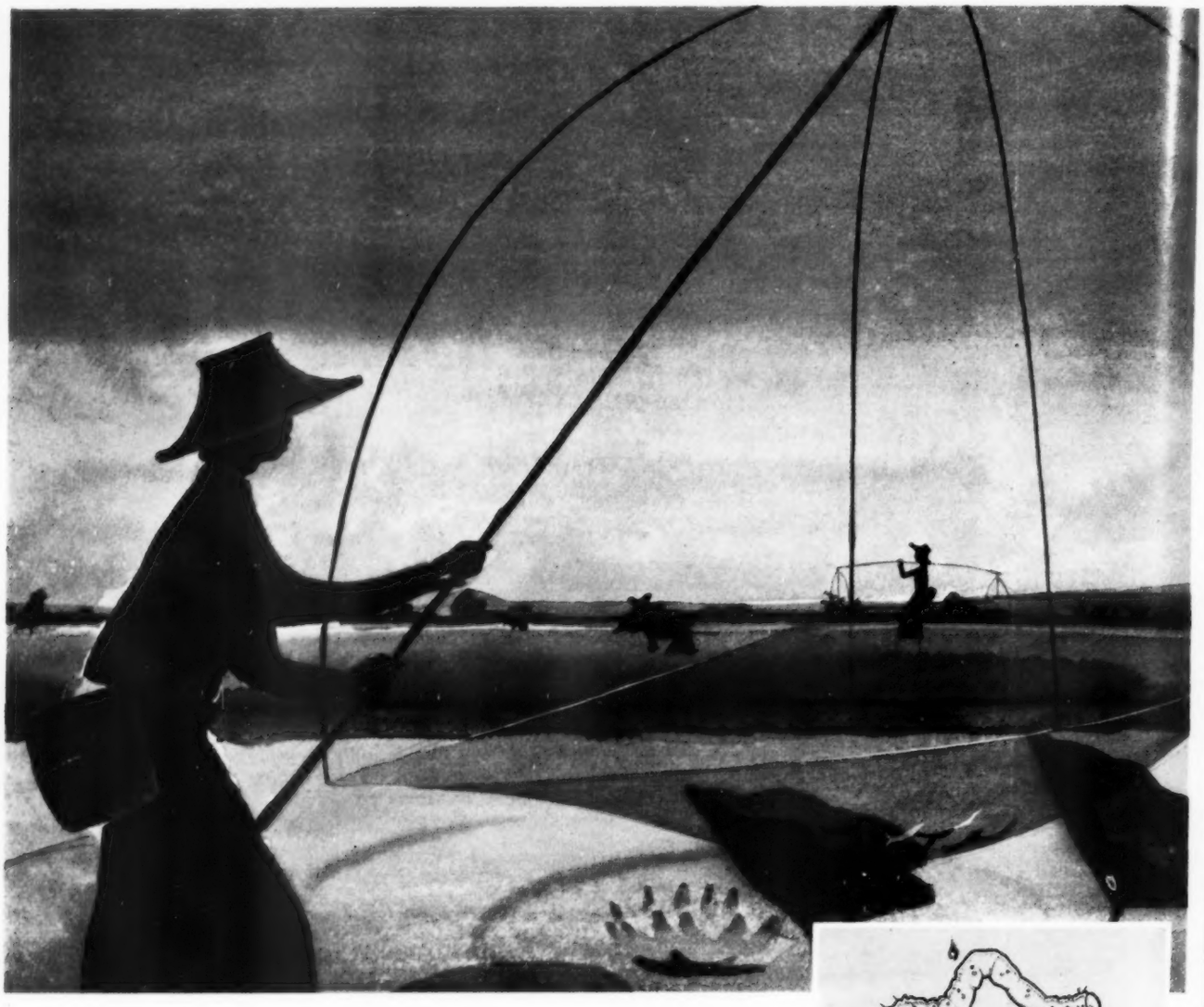
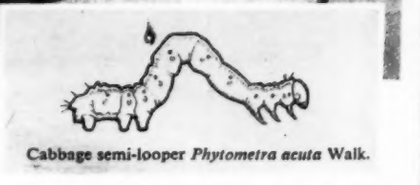
This Prototype Cane Harvester was developed in Australia by Massey-Ferguson. Mounted on a M.F. 35 tractor, it is seen operating in standing sugar cane in Queensland





Cabbage semi-looper *Phytometra acuta* Walk.

Twice best

Spreading rings to rock the sleepy lotus blossoms. A flash of gold in green-grey water, jumping silver in the meshes of the wide-mouthed net. Fish are important in the rural economy of Thailand. So, too, are vegetables. Unfortunately, what protects the one can be harmful to the other.

The main vegetable growing area of Thailand lies in the delta around Bangkok formed by the Menam Chao Phraya and neighbouring rivers, where in rich alluvial soil deposited through the centuries by the Mother of All Waters, vegetables sufficient for many millions of people are grown over a period of nine months each year. Crop protection chemicals have been used on an extensive scale for at least ten years and insecticides, in particular, are used as a routine measure. Many pests cause damage to the various vegetables grown, particularly the destructive cabbage semi-looper caterpillar—and spider mites. These pests attack the crop right up to the day of harvest and farmers are forced to continue spraying until the last moment before sending the vegetables to market.

To meet the farmers' need for an insecticide which could be used safely up to the day of harvest, Shell's new insecticide Phosdrin was tried — with immediate and outstanding success. With cabbage loopers, Phosdrin, at a few ounces per acre, achieved a complete kill *within only thirty minutes* and the same amount completely eliminated mites on cucumbers. A lower dosage gave control of cutworms and thrips on onions, and in all cases the crops *remained* 'clean' for several days after spraying. Equally important, this insecticide, despite its quick-kill power over insects, showed no harmful effect on the fish which teem in the klongs and irrigation ditches between the vegetable gardens. Phosdrin, in the eyes of those who raise both fish and vegetables in Thailand, is indeed twice best.

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Editor: Frank Cooke, A.R.C.S., B.SC., A.M.I.CHEM.E., E.D.

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Editorial Comment

Nature's Supreme Masterpiece

As AN introduction to our comments this month we quote a number of extracts from the address given at the beginning of this month to the British Association for the Advancement of Science by its President, Sir James Gray. He observed that:

'To pass from a primeval nebula to modern man without any break in continuity gives a feeling of intellectual tidiness, but quite apart from this it helps us to visualise Man against the background of his past and to regard him as Nature's supreme masterpiece. At the same time, he must not exaggerate the gap between himself and the rest of the animal kingdom.

No animal can manufacture aeroplanes, Asdic or radar, but a shearwater* has navigated the Atlantic without compass or chart, and Asdic has an extremely efficient prototype in the vocal cords and ears of bats. By surrounding themselves with an electric field some fish (*e.g. Gymnarchus*) can detect foreign objects in the surrounding water with very remarkable precision. The total weight of the mechanism involved, including the animal's brain, amounts only to a few grammes; a man-made instrument of comparable performance would involve at least a ton of highly complex electronic machinery.

Man may fairly claim that he has accomplished in a few centuries things for which Nature required many millions of years and so feel justly proud. Nevertheless, we need not feel in the least ashamed of our evolutionary past or get too big for our biological boots. Man has still a great deal to learn.

Malthus Again

WE CAN study Man from many points of view, but from a social standpoint, three are of particular interest. First, what is the relationship between the size of a human population and the resources of its environment? Second, what are the factors which influence Man's ability to acquire new patterns of behaviour? And third, what is the significance of his gregarious habit?

One of the first attempts to subject human populations to biological analysis was made by Malthus in 1789, when he forecast the fate of a nation whose rate of increase was greater than that of the resources of its environment. Malthus did not say that war, pestilence and famine were inevitable; he said that they were inevitable unless people, by voluntary control, reduced their rate of reproduction.

As soon as Man learns to discipline himself to the fact that his environment is now world-wide he can begin to direct the course of his own evolution without the discomforts of over-population. If he fails to realise his powers and allows things to drift, his future seems dark; but if he really bestirs himself, *there is no need to be afraid.*

Sir James concluded: 'The writing on the wall is tolerably clear; if Man behaves like an animal and allows his population to increase whilst each nation steadily increases the complexity and range of its environment, Nature will take her course and the law of the jungle will prevail.'

Standing Room Only

RECENTLY WE climbed to the topmost tier of the ancient Colosseum – that part reserved for the lower orders of Roman society. We picked out the headquarters of FAO, the hope of today and tomorrow, and then spotting the dome of St. Peter's – the geographical centre of Christendom – we thought back 2,000 years, only a short period in the aeons of time. We next wondered what the world would be like 2,000 years from now, and we made a calculation* which may bring home the full significance of what is happening today. Due mainly to the wonderful achievements of medical science, world population, according to Mr. B. R. Sen, the Director-General of FAO, is now increasing at the rate of 1.6% every year. Thus at compound interest the theoretical figure for world population in 2,000 years' time will be:

171,320,000,000,000,000,000,000.

Otherwise expressed, for every person living today there could conceivably be 60 thousand million people, *i.e.* 'Standing Room Only', *vide* WORLD CROPS, 1959, **10**, 435. This, of course, can never happen, but what will?

Ambitious Five-Year Plans

THE ACHIEVEMENT or near approach of independence to former colonial territories has brought with it an urge for rapid development and a conviction, on the part of many, that under 'colonialism' the pace of change and national progress was deliberately restricted. This impatience has extended to agriculture and hence we find a spate of 'experts' being introduced into the former exclusive sphere of the Colonial Departments of Agriculture and superimposed, often with not the happiest results, on the old cadre of officials.

The situation is liable to develop into the depressingly familiar pattern of rapid policy changes, enormous development programmes, plans, paper

* Shearwater: a bird of the puffin family.

* The estimated figure for world population in mid-1957 was 2,975,000,000; the formula for calculating compound interest is $A = P(1 + r)^n$.

' successes ', with, in the long run, little real achievement.

It seems likely that, in spite of the tremendous psychological and social pressure for revolutionary improvements in agriculture, that the rate of change will continue to be slow. It seems likely also that the real burden of development of research and extension will continue to fall on existing departmental staff, though to an increasing extent Agricultural Departments will be staffed by local men, locally trained.

Making Friends and Influencing People

ACCORDING TO James Gordon, of the Kumasi College of Technology, Ghana, trainees for agricultural departments should be selected on the basis of aptitude tests. This would sort out those few required for the specialist agricultural sciences, the botanists, entomologists, pathologists, soil scientists etc., and these should receive their final training in research at some inter-territorial research institution.

The larger stream should be men of a practical bent of mind, interested in farming, able to get along with people in many different stations of life and able to cope with administration without letting ' the paper work ' overwhelm them, and with a human interest in farmers and the art and business of farming for a living. We believe that a good extension or field officer should be deeply interested in farming as a craft as well as a science and should be able to translate and transmit the results of research to the working farmer. He will have to know the elements of economics and have done some reading in the social sciences, but, above all, he should be a natural leader of men.

We can conclude, without much difficulty, that much of the criticism directed at the agricultural officer – where it is not merely irresponsible or malicious – arises from defects in his training, combined with the special needs of the entirely different social and agricultural set-up from that obtaining in Europe or America. The heavy emphasis on pure science studies to the neglect of psychology, economics and farm management has been a mistake. A system, too, which over-stresses and over-rewards academic ability is unsatisfactory. Leadership and practical ability need also to be recognised and rewarded if the targets of ambitious plans for agricultural development are ever to be reached.

Will to Win

MEANWHILE, THERE is the more immediate problem – what of our children's children? With populations moving in excess of their increase in agricultural production the administrators of predominantly agricultural countries, whose job it is to guide the fortunes of these countries, have a difficult task. Where it is possible to increase production simply by opening up new areas the problem is relatively straightforward – all that is needed is financial aid and technical advice; where the problem is to obtain increased production from the same acreage, what is then required in addition is the will to win – to do better.

It is now customary in the under-developed countries to consider the agricultural sector as a ' primitive ' form of economic activity and to wish for industries, especially the ' gadget ' industries, and iron and steel. What is often ignored is the fact that agriculture is primitive only when it has a low productivity per head; many Western countries have built high incomes on agriculture alone simply by raising productivity.

Ten-Year Planning

CEYLON'S NEW Ten-Year Plan of Development (1959–68), under which some Rs. 13,600 million (about £1,000 million) would be devoted to capital formation in all sectors of the economy, has an apparent bias towards such industrialisation – a bias that is more apparent than real. In fact, the plan leans heavily (and realistically) on agriculture to provide jobs for the 1,219,000 people who, it is reckoned, will join the island's work force during that period.

Ceylon's population problem is big enough to daunt the hardiest of planners. With a growth of about 2.6% (world average is 1.6%), her population will conceivably double over the next 25 years. With every mouth, it is true, comes a pair of hands – but there is not enough work for the hands that exist, let alone for those that are just coming to working age.

The plan makes a strong plea for a family limitation campaign; it points out that, although this can hardly affect the economic problems of the next 10 years, the effect on standards of living can be immediate, in that parents can be immediately relieved of many costs in the home, by ceasing to bear the ' devastating torrent of children '.

In its economic aspect Ceylon's new plan is realistic. There only remains, however, to ask the question: Will the people realise that it can be accomplished only if political and social stability are assured?

More Per Acre

THE ISLAND'S agricultural potential is indeed great in terms of output and of employment.

The tea estates, now producing at an average level of 771 lb. per acre, could produce 2,000 lb. an acre; rubber production could be 1,100 lb. an acre – it is only 375 lb. at present; coconut yields of 3,000 nuts an acre are possible, against the 2,150 nuts per acre, the present yield. And in the staple food crop, rice, the existing low yield of 32 bushels an acre is incredible; it results in the astonishing fact that the island depends on imports for over half its cereal foodstuffs, these imports costing Rs. 346 million in 1957.

Taken all in all, Ceylon's output of agricultural produce could be doubled without an additional acre of land being called into use. As for jobs, the long-term prospect is that well over a million more people could be economically employed in agriculture.

Rising incomes would call for all kinds of service and for manufacturing and importing activities in the island and this will provide the best basis for the much-desired industrialisation.

Spotlight on Coconuts

WE MAKE no excuse for referring at length to coconuts, as this is a matter of vital importance to all countries where this crop is a leading source of income. Ceylon has hitherto given the lead on account of the successful development of her Coconut Replanting Programme, the successful implementation of a Fertiliser Subsidy Scheme, the long-term researches in the development and proving of hybrid varieties, and in the establishment of an Isolated Coconut Seed Garden.

In the Plan the target acreage for the replacement of low-yielding and senile palms is given as 25,000 acres per annum, as against the former replacement rate of 15,000 acres per annum, which was based on an economic life of 70 years and a total area under coconuts of just over a million acres, *i.e.* 1½% per annum. As this only provides for replacement, it may probably not be enough to meet the needs of future generations, even though much better planting material is used than was the case 70 years ago.

The target is therefore rightly set high, but if selection standards are allowed to fall it is doubtful whether the principal object will be achieved. It was with some surprise, therefore, that we read in the Ceylon press that, in order to speed up the rate of replanting, it had been decided to relax the standards of selection, so as presumably to obtain more planting material without extra cost. We have even been informed that there is actually no selection of the seedlings now being sold to the public. If correct, this is not an example which other coconut-producing countries should follow, for nothing but the best is good enough when replanting.

A sturdy, well-shaped palm may yield between 30 and 250 nuts per palm per annum, according to the environment, whereas a weedy, up-standing palm will yield between nothing and say 30 nuts per palm per annum.

Selection must therefore be restricted to seed nuts which show early vigour and produce seedlings which have a large number of broad leaves with short, thick petioles, thick stems and a large number of roots. Weak seedlings showing poor and stunted growth and those with a lean, up-standing habit of growth must be rigorously discarded.

The roguing out of inferior seedlings is even more important than the selection of ' mother ' palms and seed nuts, as all nuts produced on tall palms are of mixed parentage due to cross-pollination. With rigid standards of selection as much as half the seedlings produced may be discarded and destroyed, and this is an expensive matter, but the cost is small when compared with the total financial loss resulting from fewer nuts per palm over its life of three score years and ten.

Water for Tea

IN MANY countries overhead irrigation is now used in tea nurseries, but planting opinion is, in general, opposed to the irrigation of established tea. It is felt that if tea cannot grow and flourish under a good canopy of shade without artificial watering, then the environment is unsuitable.

Most of the experiments with high-pressure irrigation have been carried out in north-east India, in Assam and Bengal. The Nowgong district of Assam is located in the ' rain shadow ' of the Shillong plateau, where the spring rains can sometimes be inadequate. The Terai area of Assam, too, is often outside the moist front which brings the early rains to the Assam valley.

In both these areas high-pressure irrigation will certainly do good and increases of about 200 lb. of tea per acre have been recorded. It is also considered that where the rainfall is fluctuating it might benefit young tea which has not yet developed a deep-rooting system.

There is a unique case of channel irrigation on an estate in Southern Rhodesia, where the annual precipitation is only 25 in. (30 years' average) against the 45 in. in the surrounding country. Fortunately, the Tanganda River flows through the valley where the estate is situated and the lie of the land lends itself to channel irrigation. It is interesting to note that the crops obtained are the same as those on estates with adequate rainfall and the same temperature conditions.

Oils and Oilseeds

THE WORLD is largely dependent on tropical countries for vegetable oils, such as coconut, palm, groundnut, castor, sesame and cottonseed, which, despite important plantation developments in some regions, are still mainly grown on smallholdings. In earlier days, because of lack of knowledge, resources and skill, only the simplest forms of processing were possible in producing countries and excessive amounts of oil were left in the residue. Power-driven expellers being beyond the reach of smallholders, large processing industries were established in temperate countries by companies to whom the maintenance of existing conditions became a matter of vital concern.

Although doubtless regarded with disfavour by oil millers in these countries, there seems to be no *prima facie* reason why manufacturing operations at present carried out in temperate countries should not be performed in the tropics, thereby substituting export

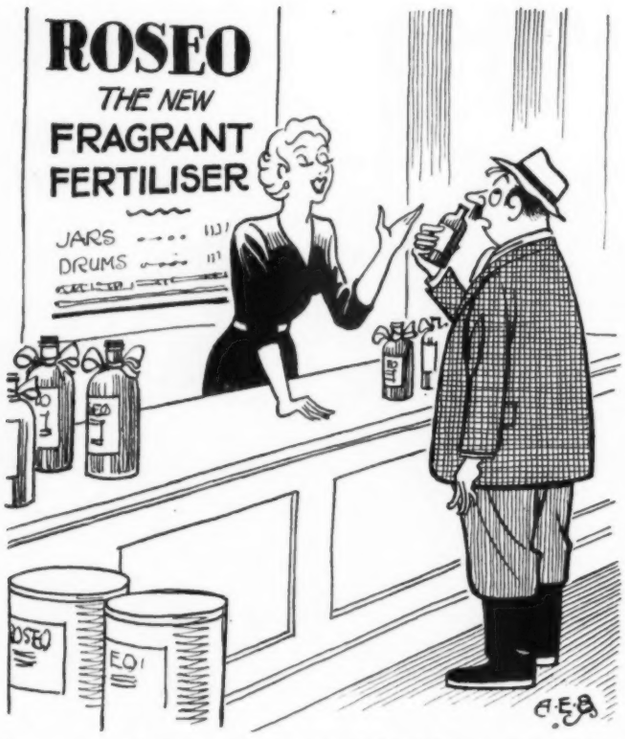
trade in manufactured produce for one in raw materials. If only oil is exported, large amounts of plant food are retained in the country of origin and the steady drain on fertility consequent on exporting the whole seed is considerably reduced. It also ensures that the press cake or other by-product of oil milling is available for local livestock.

The present tendency is towards elimination of export of raw products in favour of oil extraction and preparation from oils of finished products, such as margarine, soap and cooking oils, in countries of origin. The intense nationalist feeling in most countries has served to stimulate the demand for locally manufactured goods and it is clear that industrial development of vegetable oil products is established in many tropical countries and is bound to increase in the future.

There remains one difficulty. Where a crop is seasonal and perishable, *e.g.* copra, the mills can only be in seasonal operation. Fluctuating demand will cause fluctuating prices, which will make life more difficult for the primary producer.

Sixes and Sevens

E.F.T.A. IS now at ' sixes and sevens '. Six countries – France, West Germany, Italy, Belgium, Holland and Luxembourg – agreed to cut tariffs among themselves as from the beginning of the year. Seven – Sweden, Norway, Denmark, Austria, Switzerland, Portugal and the U.K., with a combined population of 90 million people – are now having discussions on the feasibility of gradually eliminating tariffs and quotas and so establishing a similar multilateral association to provide opportunities for expanding trade between them.



' . . . and, of course, a spot or two behind the ears after you've cleaned the pigs out '. (In the U.S.A. pleasant odorants are being added to fertilisers to assist sales promotion—Ed.)

After the breakdown of the negotiations between the original 17 countries of Western Europe something had to be done, as the 11 outside were faced with a serious situation due to loss of markets. In the latest negotiations between the ' Seven ', Sweden has taken the initiative, but the Stockholm Plan should not be considered as a retaliation, but rather as a measure for self-preservation; it is intended actually to improve the bargaining position of the ' Seven ' in relation to the ' Six ', so that ultimately an agreement may be reached between the 17 for the establishment of the European Free Trade Area for the benefit of all.

Up to now, the discussions of the ' Seven ' have been directed towards the establishment of a free market for manufactured products, with the gradual elimination of tariffs and quotas over a period of years. But one of the thorniest problems of the ' Seven ' is whether these should be lowered for agricultural produce, a matter of special concern to Denmark and, of course, the U.K. (Previous references: WORLD CROPS, 1958, 379 and 393; 1959, 2 and 205.)

A compromise has been proposed whereby the British tariff on bacon, canned luncheon meat, canned cream and Danish blue cheese is to be removed, but there are to be no concessions for butter, hard-pressed cheese or eggs, in which there are strong Commonwealth interests. While the bacon-curing industry in Britain will lose the advantage of the tariff, the pig industry will continue to be supported by the Guaranteed Price Scheme.

Another important consideration is that, according to statistics published by the Ministry of Agriculture, Fisheries and Food, Denmark was the leading overseas buyer of British tractors (£1.4 million); Australia came next with £1.2 million.

News from Java

ACCORDING TO the East Java Estate Department, Indonesia now has 1,520 agricultural estates with a total area of 5½ million acres, of which 1,243,689 acres are under rubber, 246,000 acres under oil palm and 208,000 acres under tea.

Compared with pre-war days, production, especially of coffee and tea, seems to have fallen by almost 50%, due to delay in undertaking new planting and to neglect and damage during the Japanese occupation. We learn that of the 1,520 estates, 83 are owned by Indonesians, planted with 30,764 acres under rubber and 14,735 acres of tea. Netherlands-owned estates, now placed under Government supervision, number 673, with an area of 2¾ million acres. The British own 875,000 acres and the French 92,000 acres, while American, Belgian and Swiss estates have an area of 486,000 acres. Chinese- and Arab-owned estates total 610,700 acres.

The Machine in Tropical Agriculture

1—Climatic Zones and Land Types

RAY WIJEWARDENE, B.A. (MECH. SC.), M.A., A.M.I.B.A.E., M.A.S.A.E.

The author of this illuminating series of articles is no armchair adviser; he is a practising farmer and inventor who was one of the first to introduce mechanical methods into the rice and coconut growing industries of Ceylon.

Photo: U.S.I.S.

The buffalo and certain other hardier breeds of tropical cattle are better suited to paddy cultivation than the horse

IN most tropical countries the extent of land which a man can cultivate is limited by the strength of his arm, the fitness of his work animals, and the size of his family. Today and ever-increasingly he needs to be able to produce more and more to improve his standard of living and to help to meet the needs of the growing community in which he lives – one man should produce enough for 20.

Manufacturers of agricultural machinery have tried for many years to adapt the conventional tractor, designed originally to work in the temperate countries and with temperate zone crops to operate under conditions of tropical agriculture. So far these endeavours do not seem to have met with much real success.

Photo: FAO

In the 'C' type zones the lands are usually so waterlogged in the wet weather that they are useless for any crops other than paddy. Here is seen a tractor specially adapted for rice cultivation

In searching for causes to which this failure can be attributed, some blame the village farmers and others the economic and social structure in tropical countries. Neither suggestion is so sound as the view that the tractor itself may be the root cause of the trouble in its inherent unsuitability to the socio-agro-climatic conditions encountered in the tropics.

By way of analogy, a horse, though the ideal draft animal in the temperate countries, adapts very poorly to rice cultivation, a field in which the buffalo and certain other hardier breeds of tropical cattle are far better suited.

The first problem is to decide whether there is a place for agricultural machinery in the tropics. One fact alone indicates the answer: rice, which is the staple food of by far the greater proportion of the people in this world, is grown almost entirely in the tropics by manual labour and with the aid of draft animals.

With rapidly increasing populations

LAND TYPE	"A" TYPE LANDS	"B" TYPE LANDS	"C" TYPE LANDS	"D" TYPE LANDS
ONE-MONSOON DRY ZONE CROPS	Forestry	Pasture, under shade trees rotated with dry crops:- Sorghum, Dahl, Maize, Ground nuts, Cow pea, Chillie, Tobacco, with sprinkler irrigation if available.	Coconut, Pasture, rotated with dry-sown Paddy.	Paddy, under irrigation.
TWO-MONSOON WET ZONE CROPS	Forestry Tea Rubber Coconut Cocoa	Tea Rubber Coconut Cocoa Tobacco Cotton Citrus } in sheltered areas	Pasture Coconut Rubber Paddy } if well drained	Paddy, rain fed, and irrigated
PROFILE OF CEYLON	"A" Type	"B" Type	"C" Type	"D" Type

Chart showing tropical land classification and crops usually grown on them whether they fall within the one-monsoon or the two-monsoon wet zone

and industrial development, increased use of machines of the correct type would therefore appear to be sound policy. Perhaps climatic conditions, more than any other, define the limits to which mechanisation may be applied in tropical countries.

Climatic zones

Nearly all tropical countries can be divided into two zones, the two-monsoon or wet zone and the one-monsoon dry zone. The period between these monsoon rains being near-drought in most areas, irrigation is essential either from man-made reservoirs or from wells and rivers.

The word ' deluge ' is the only one which adequately describes the monsoon rains, which last five to 10 weeks, during which time anything between 40 and 120 in. of rainfall may be expected. Amongst plantation crops only hardier plants, such as rubber, coconuts and tea, coffee and cocoa, can stand up to these extremes. Cotton, citrus and other more delicate plantation crops grow only in the comparatively sheltered areas which do not suffer the full onslaught of the rains and the climatic extremes.

Nevertheless, the wet zones are relatively very productive compared with the dry, one-monsoon zones, which are still a problem almost everywhere. Here the dry spells are too long for even the hardier plantation crops and the wet spells too intense for almost all the short-term arable crops, except rice in the low lands and pastures in the higher better-drained lands. The tremendous fluctuation in water table (0–50 ft.) with the extremes of weather is another feature of these dry zones, where it is difficult to farm at all, let alone farm with machinery.

Even temperatures are against the farmer, the heat and poor distribution of rainfall rendering less than 20% of the total precipitation available to crops struggling for existence on these lands.

Land classification

Broadly, land types in the tropics fall into four categories: the better-drained lands, usually referred to as the 'A' and ' B ' types; and the lower waterlogged and generally flatter lands, referred to as the ' C ' and ' D ' types. The 'A' type, or watershed, is usually better left in forest, although vast areas of such land have been opened up in tea and rubber; in fact, with quite a variety of crops.

The ' B ' type is, however, of great interest to those concerned with power farming, as it is usually well drained and undulates gently between the steep slopes of the 'A' type and the flatter waterlogged lands of the ' C ' and ' D ' types. The ' B ' type in the one-monsoon dry zone can be cultivated with perennial pastures and legumes in rotation with arable crops, such as maize, sorghum, groundnut, gingelly seed, cow pea, etc., but these are risky and only grow properly when the monsoon fails in its customary intensity.

In the two-monsoon or wet zone, however, plantation crops are ideally suited to the ' B ' type and it is usually in these areas that coconut, rubber, cocoa and low-grown teas flourish, although the fluctuation of yields with the weather is very noticeable.

The ' C ' and ' D ' types are those usually so waterlogged in the wet weather that they are quite useless for any crops other than paddy. The ' C ' type, however, being higher, is somewhat better drained and is capable of rotated crops under controlled irrigation during the dry weather or plantation crops in the wetter areas provided adequate drainage is provided. The ' D ' is so low in the soil catena that it is invariably boggy and marshy after a shower or two even in the dry seasons. Paddy is about the only crop that will grow on these lands.

(*Continued on page* 313)

Plantation crops are ideally suited to the ' B ' type zone. Here a tractor is seen subsoiling the ground between the rows of coconut palms

Preparing Land for Cacao in Ghana

Land Clearance for Field Experimentation

H. W. S. ALLISON AND R. K. CUNNINGHAM
(*West African Cocoa Research Institute, Tafo, Ghana*)

T. N. Hoblyn, in his article, 'Some Difficulties in Field Experimentation with Cocoa on the Gold Coast', published in WORLD CROPS,* *concluded that 'the usual method of growing cocoa in the Gold Coast today permits of only the simplest field experiments, calling for generous replication to provide clear-cut answers to straightforward questions. More elaborate experimentation must await the evolution of methods of clearing and rehabilitating land before planting'.*

IN the three years which followed the publication of the above observations various techniques have been introduced at the West African Cocoa Research Institute to overcome some of the difficulties of land selection, clearing and planting. Such techniques are new to Ghana, where the plantation system is unknown and cacao is grown on an immense number of small peasant farms.

Before reviewing the methods used it should be emphasised that the main aim has been to provide a fairly large area of uniform cacao suitable for accurate field experimentation. Consequently, it has been necessary to take into account some factors which would be ignored in normal plantation practice. Preliminary results of the present fertiliser programme at WACRI indicated the need for a large-scale, long-term shade and fertiliser experiment on clear-felled land.

For this purpose a large block, preferably of secondary forest with uniform soil conditions, was required. The cheapest and simplest method of clearing, by burning the timber *in situ*, was considered inadvisable because little is known of the short- and long-term effects on soil uniformity and cacao establishment. The main problems involved, therefore, were the removal of the very heavy stand of timber with minimum disturbance of the surface soil and the prevention of soil deterioration during the period of exposure before establishment of planted shade trees. The following procedure was finally adopted:

The soil survey of the Square Mile at WACRI by the Ghana Department of Soil and Land Use Survey made it possible to select a jungle area of about 35 acres containing only one soil series and covered mainly by old secondary forest (see background of Fig. 1). After cutting traverses 100 ft. apart throughout the area, a detailed survey of rock outcrops, streams, valleys, old village sites, fallen trees and standing timber was made. A map indicating these details was used to estimate clearing costs and work out a clearing and planting programme which was divided into four phases.

Fig. 1. Directional felling with the secondary forest in background

Fig. 2. Cutting one of the larger trees into 10-ft. lengths

First phase

Clearing of undergrowth and saplings. A D-4 caterpillar tractor, fitted with

* Hoblyn, T. N., World Crops, 1956, 8, 355-360.

Fig. 3. D-4 (blade well above ground) rolling log to block boundary

a bulldozer blade, uprooted saplings 2 to 3 in. in diameter with little soil disturbance and also crushed undergrowth, 3 to 4 ft. high, into a protective mat, which was allowed to lie on the surface of the soil. Providing conditions were dry, this covering of crushed vegetation reduced to a minimum any soil disturbance by the caterpillar tracks.

Second phase

Felling of timber. A team of skilled axemen, using Trieweiler monkey winches, followed the D-4, felling the timber into parallel rows (see foreground of Fig. 1).

Third phase

Cutting and removing timber. After felling, the local villagers were permitted to carry off all the light timber for firewood, whereas the heavy timber was cut into 10-ft. lengths (see Fig. 2) and then removed by two methods. The suitably shaped logs were rolled off by the D-4 with its bulldozer blade kept 4 in. above ground level to avoid surface soil displacement (see Fig. 3). The remaining logs were carried off by manual labour. In each case the timber, which had no commercial value, was stacked at the block boundaries (see Fig. 4) and eventually used as fuel. An estimate of the total amount of timber removed from the site is given in Table 1.

Stump removal was not carried out because it is costly and causes large undesirable areas of exposed subsoil. This problem is well illustrated by Fig. 5, which shows the massive buttresses and stump of one of the larger trees.

Protection of the surface soil at this stage is especially important because direct insolation results in a serious loss of organic matter. Trials are being carried out at WACRI to select a suitable cover crop, but no definite choice has yet been made. Natural regeneration of undergrowth was therefore allowed; this persistently maintained a good protective cover, although crushed by each successive passage of the D-4.

Table 1

Heights, diameters and estimated weights of removed timber

No. of trees	*Height range (in ft)*	*Diameter range (in ft)*	*Air dry weight* (in tons)*
2	240	6–7	83
204	120–150	4	1,805
696	90–120	3–4	3,688
356	60–90	2–3	684
277	<60	1–2	77
156†	40–50	1.5	64
Grand total for 35 acres			6,401
Density of timber removed			183 tons per acre

* Estimated by assuming a cone shape for each range and an average air dry density of 35 lb. per c.ft

† Oil Palms

Fig. 4. Timber stacked at block boundary

Fourth phase

Planting of shade and cacao. The felling and clearing was completed by the end of the dry season, and at the beginning of the rains in April, the temporary and permanent shade trees were planted as illustrated in Fig. 6. Quick-growing temporary shade was provided by tree cassava, *Manihot* sp., planted as cuttings at 10 ft. × 10 ft. and *Terminalia ivorensis* seedlings, raised in baskets in a nursery, were planted as permanent shade at 20 ft. × 20 ft. The tree cassava will be removed, probably after two years, when the *Terminalia* is providing adequate shade.

At the onset of the heavier rains in June, when the tree cassava was already 2 to 3 ft. high, the lines of this temporary shade were brushed and planting holes were dug for the cacao. One ounce 15-15-10 compound NPK fertiliser was placed at the bottom of

Table 2

Establishment costs

Item	Man days per acre	Tractor days per acre*	Cost per acre £	s.	d.
Preliminary brushing	15	—	4	0	8
Clearing of undergrowth and saplings (D-4)..	—	1.8	3	12	0
Felling timber	55	—	18	15	6
Cutting logs	76	—	20	8	6
Log removal (manual)	95	—	25	10	8
,, ,, (D-4)	—	3.8	7	10	10
Pegging, lining and mapping ..	17	—	4	11	5
Planting temporary shade (tree cassava)	4	—	1	1	6
Planting permanent shade (*Terminalia ivorensis*)	6	—	1	12	3
Planting cacao	7	—	1	17	8
Fertiliser and application	0.2	—		13	0
Temporary palm frond shade ..	7	—	1	17	8
Supervision (headman)	11	—	6	9	7
Total	293.2	5.6	£98	1	3

* The cost of operating the D-4 caterpillar tractor was estimated at £2 per day

Fig. 5. Buttresses and stump of one of the larger trees, with man standing beside

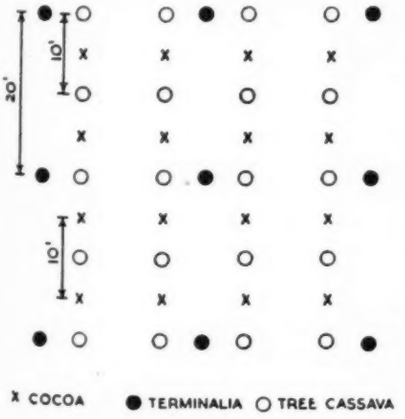


Fig. 6. Field layout of cocoa and shade

each hole. Finally, Amazon cacao seedlings from open pollinated pods of varieties T60 and T79 (reciprocal crosses) were planted as basket seedlings at 10 ft. × 10 ft. (see Fig. 6) and were protected by a tripod of palm fronds until the formation of a tree cassava canopy.

Details of costs, from the preliminary brushing in May 1958 until the planting of cacao in June 1959, are shown in Table 2.

ACKNOWLEDGMENTS

The authors are grateful to Mr. J. Lamb, Director, WACRI, for help given throughout this work. They also wish to thank members of the WACRI senior staff who took the photographs used in this paper.

Arid Zone Research

The Negev Institute for Arid Zone Research in Beersheba has a pilot plant for saline water research, paid for by a grant of approximately £40,000 from the U.S. Government. It will produce 10,000 gal. of fresh water per day from underground brackish water by an electrical process using special membranes. It has been designed and constructed at the Institute's electrodialyses research laboratory with the main object of determining the cost of producing desalinated water for irrigation in selected areas of the Negev. A small self-contained domestic desalination unit with a capacity of 250 gal. per day is also being tested.

The Machine in Tropical Agriculture—1

(*Continued from page* 310)

A further classification is possible by districts – those near the coast, being sandy, are easier to work. The lands further inland are higher in quartz and clay and generally lateritic and low in calcium. They are workable so long as there is sufficient rain to keep them moist, but as soon as really dry weather sets in they bake hard as a concrete floor. Any attempts at cultivating soils in this condition with machinery generally results in considerable damage to both implement and soil.

Only 'B' and 'C' are broadly suited to conventional tractor operations, 'A' being generally too steep and rocky, while 'D' is unsuitable, being too soft and marshy to support a tractor without wheel extensions.

It will be appreciated that if the conventional tractor is only capable of working in the 'B' and 'C' types, its use in powering tropical agriculture is greatly restricted, with such a large proportion of crop land in those countries within the 'A' and 'D' types. Even so, attempts to adapt the tractor to the cultivation in the 'B' and 'C' types can only be considered partially successful. This is perhaps the reason why tractors in the tropics are mainly used for transportation, a cheap and convenient form of truck, only a very small proportion being used for cultivation.

(*To be continued*)

NOTE FOR CONTRIBUTORS AND AUTHORS

The editor welcomes authoritative articles and news items on agricultural machinery and agricultural methods, agricultural crops and new developments.

A short synopsis should preferably be included to assist the editor and the manuscript itself should be typed in double spacing with plenty of margin and on one side of paper only.

It should bear the name and address of the author and be accompanied by sharp photographs or line drawings with suitable captions.

Storage, Transport and Shipment of Cocoa

1—Prevention of Moulding in Storage

B. D. POWELL, M.A., PH.D., F.R.I.C., AND G. A. R. WOOD, B.A., D.T.A.

A discussion of methods of preventing dry cocoa from taking up moisture and becoming mouldy in countries where climatic conditions are difficult.

Cocoa beans being mixed outside the store at Kumba in British Cameroons

MOULDS cause damage to a wide range of foodstuffs, for generally they will flourish as long as the temperature is suitable, the water supply adequate and the necessary nutrients are available.

Internal moulding is a serious, probably the most serious, defect of commercial cocoa. Moulds on the shell, if inconsiderable, have little significance, but occasionally they penetrate into the cotyledon in a form which is invisible to the naked eye and adversely affect the subsequent chocolate flavour.

In the case of stored cocoa beans in tropical areas, the controlling factor is that of water content and the critical value is about 8%.[1] Cocoa beans are hygroscopic and when placed in an atmosphere whose relative humidity is in excess of 80% they attain an equilibrium moisture content in excess of 8%, more or less rapidly. This moisture content of 8% refers to the whole bean. Since the fat content (cocoa butter) of the cotyledon is about 55%, and of the shell about 3·5%, the moisture content of the non-fat portion of the cotyledon and of the shell is about 17%. (Water is almost insoluble in cocoa butter.)

The rate of absorption of moisture is greater as the moisture content of the bean is further away from its equilibrium value. An isolated cocoa bean will attain its equilibrium moisture content in a matter of days, while cocoa in a free-standing bag will take several weeks. With a large stack the time will be even longer.

Table 1 shows the equilibrium moisture contents at various atmospheric relative humidities.

A store where the weighted average daily relative humidity is in excess of 80% is unsuitable for the prolonged storage of cocoa.

In most areas of the large producing countries, like Ghana, the climatic conditions are such that special provisions for storage are unnecessary. Other areas, *e.g.* British Cameroons, are less fortunate in their climatic conditions and special steps must be taken if good quality cocoa is not to deteriorate by moulding during storage.

The three methods of dealing with this problem are either: (1) improving the atmosphere within the store, (2) ensuring that the storage period is insufficient for deterioration to take place, or (3) protecting each individual bag of cocoa separately.

Table 1

Relative humidity, %	*Moisture content*, %
75	7·3
80	7·7
85	8·7
90	11·6
95	15·5

Heated stores

When the temperature of a given mass of air is raised the relative humidity will fall; for example, a rise of 10°F from 75°F to 85°F will reduce the relative humidity from, say, 89% to 65% (moisture content of air 8.4 grains per cu. ft.).

It is readily seen that this principle has, in theory at least, an application to the problem under consideration, but in practice it is unlikely to lead to an acceptable solution on grounds of cost. Oil and wood are the only possible fuels and both are expensive. Furthermore, any store heater must release no fumes in the store, and if non-automatic in operation it must be carefully controlled and diligently

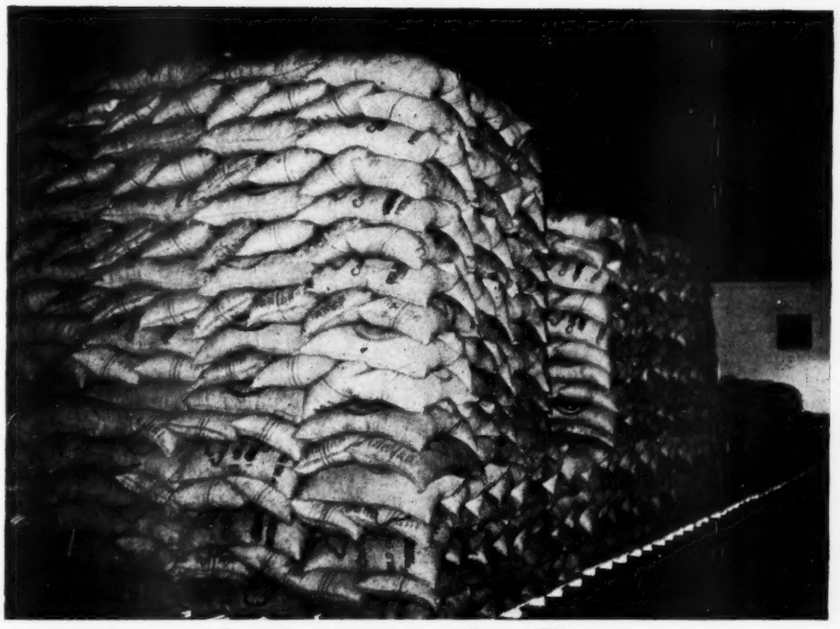
stoked. An increase of the already high temperature in a store could also make working conditions intolerable.

Air-conditioned stores

The alternative to reducing the relative humidity of a given mass of air by raising its temperature is to remove water from it. Here the cost of installing an air-conditioning plant, as well as its running and maintenance, will be high and the supply of electric power becomes necessary.

Improved operation

Mademoiselle Sauda[2] showed that cocoa stores can be designed and operated in a manner which will, to some extent, offset the effect of unsatisfactory climatic conditions. Her work was done on the coastal stores at Douala in the French Cameroons, where the atmospheric relative humidity varies during the day, reaching a minimum about noon and a maximum about midnight. She recommended that stores should be opened between noon and 5 p.m. to admit air of lower relative humidity and closed tightly at night to exclude air of higher relative humidity. In this way, the average relative humidity is reduced and the cocoa has a more satisfactory environment.



Bags of cocoa in store at Accra, Ghana

This argument is only sound when there is little variation in air temperature during the 24 hours, an important condition not referred to in the paper. Otherwise the air trapped in the store when it is tightly closed will cool and as a consequence the relative humidity will rise.

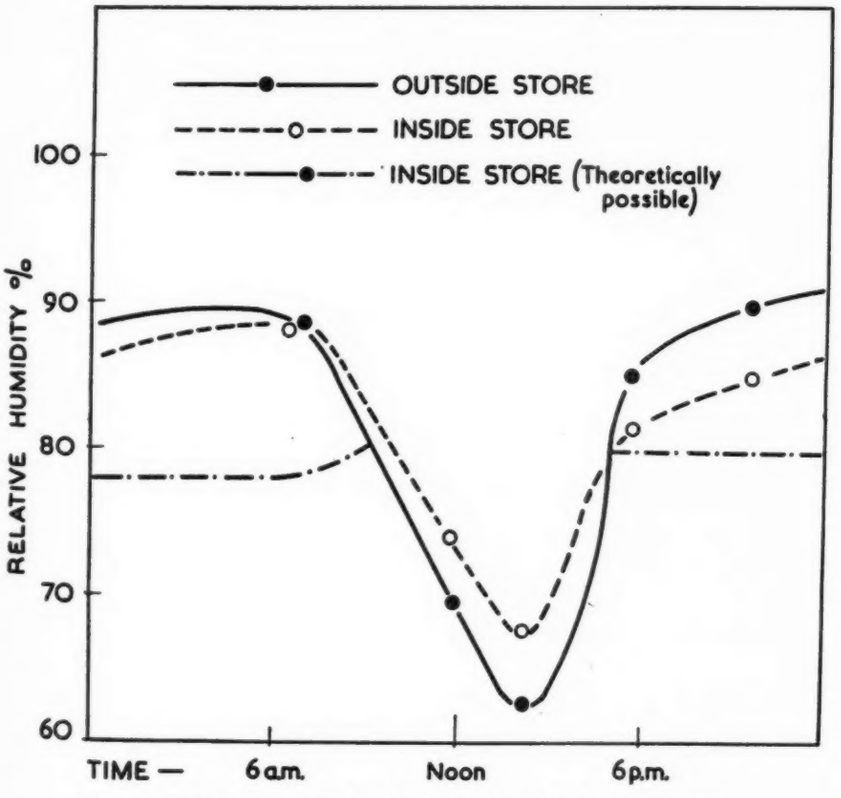


Fig. 1. Relative humidity (av.) inside and outside the Kumba store

Improved construction and operation

A store at Kumba, 62 miles inland from Victoria in the British Cameroons, which was proving unsatisfactory for the prolonged storage of cocoa, was examined to see whether it could be improved by a change in design and operating practice. The walls were constructed from cement blocks 8 in. thick and the roof was of aluminium, supported on steel girders. Neither the louvres in the walls nor the large ventilator over the porch had means of closing.

It was first necessary to collect data relating to temperature and humidity and wet and dry bulb hygrometers were hung 5 ft. above ground level at two positions within the store, and at two positions outside, protected from rain and sun. They were read several times a day and the results for one day are given in Fig. 1. It is seen that the relative humidity, both inside and outside the store, varies during the day, reaching a minimum at about noon and a maximum at about midnight. The weighted averages for four weeks have been calculated and are shown in Table 2.

Cocoa kept in such a store would be expected, sooner or later, to attain a moisture content of over 8% and go mouldy. It was found by experiment

Table 2

Week beginning	*Outside store*	*Inside store*	*Inside store (theoretically possible)*
24 August	85.5%	85.3%	78.9%
31 August	84.7%	85.2%	77.6%
7 September	82.8%	82.7%	76.9%
14 September	84.6%	83.5%	78.6%

that a free-standing bag of cocoa, moisture content originally about 5%, attained a moisture content of 8% and went mouldy within four weeks.

An improvement in conditions could be expected by replacing the louvres with shutters which open and providing additional ones, closing the ventilator over the open porch and either insulating the underside of the roof or providing an insulated false ceiling.

During the period when the store is worked, 7 a.m. to about 4 p.m., the outside relative humidity (Fig. 1) is less than that inside, so by opening all the doors and the new shutters to give free circulation of air advantage can be taken of this factor. If the store can be closed tightly in the afternoon, and its temperature prevented from falling, the relative humidity will remain constant at its value when the store is closed.

The chain curve (Fig. 1) represents the conditions obtainable with perfect insulation, and column 4 of Table 2 shows the calculated mean – a clear improvement – and a humidity in which dry cocoa should neither reach 8% nor go mouldy. It is a practical matter to approach this figure (though to calculate the actual nearness of approach to the 'ideal' figure is very difficult) by applying insulating material to the underside of the roof, or the upper surface of a false ceiling. Since the walls of the store are made from 8-in. cement blocks it is not considered that any insulating material should be applied to them. Care is needed in the selection of the insulating materials to avoid anything which will harbour insects.

(To be continued)

REFERENCES

1. Bunting, R. H., Dade, H. A., and Scott, J. L., *Gold Coast Department of Agriculture Year Book*, 1928.
2. Mlle. Sauda, *Café, Cacao, Thé*, No. 1, 1, 1957.

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Coming Events

Agricultural Aviation. – The first International Conference on Agricultural Aviation to be held in Europe takes place from 14–19 September at the College of Aeronautics, Cranfield, Bedfordshire, England. The Conference is being held at the request of the European Agricultural Aviation Centre at The Hague. Registration forms may be obtained from the Ministry of Agriculture, Fisheries and Food, Room 218, Great Westminster House, Horseferry Road, London, S.W.1.

Grassland. – The 8th International Grassland Congress will be held at Reading, England, from 11–21 July, 1960. Enquiries and requests for application forms should be addressed to the Secretary, 8th International Grassland Congress, Reading, Berkshire, England.

Agricultural Exhibitions

England. – The Smithfield Show and Agricultural Machinery Exhibition at Earls Court will be held from 7–11 December this year. Enquiries should be addressed to the Smithfield Show Joint Committee, Forbes House, Halkin Street, London, S.W.1.

Hungary. – The Agricultural Fair in Budapest takes place from 4–20 September. Enquiries should be addressed to the Hungarian Chamber of Commerce, Budapest 62, P.O. Box 106, Hungary.

Italy. – The Levant Fair this year will be held from 6–21 September. It is the largest industrial and agricultural exhibition held in Southern Italy. Further information from M. Neven du Mont, 123 Pall Mall, London, S.W.1.

Australia. – The Royal Agricultural Show at Perth, Australia, takes place from 2–8 October. Further details from Royal Agricultural Society, 9 Howard Street, Perth, Australia.

Switzerland. – The Swiss Agricultural and Dairy Show is to be held from 8–18 October at Olma. Enquiries to Swiss Legation, Commercial Section, Montagu Place, London, W.1.

India. – New Delhi will be the centre for a World Agricultural Fair to be held from 11 December–14 February, 1960. Further information from World Agricultural Fair, Exhibition Grounds, Mathura Road, New Delhi.

Corrosion Exhibition moves to Olympia

The biggest step yet in the history of the Corrosion Exhibition will be taken with next year's show. From the Royal Horticultural Hall it is being promoted to Olympia, where the whole of the Empire Hall has been booked. This means that the 1960 Corrosion Exhibition will be twice as big as the 1959 show held last April. Stands will be bigger and there will be more and better facilities for visitors.

The Exhibition will be open from Tuesday, 29 November, to Friday, 2 December. A complete range of anti-corrosion materials, methods and equipment will once again help industry to fight the menace that costs Britain £600 million a year.

The Corrosion Exhibition is organised by *Corrosion Technology*, a Leonard Hill journal. Bookings are now being accepted and full information is available from The Organiser, Corrosion Exhibition, Leonard Hill House, Eden Street, London, N.W.1.

Electricity v. Weeds

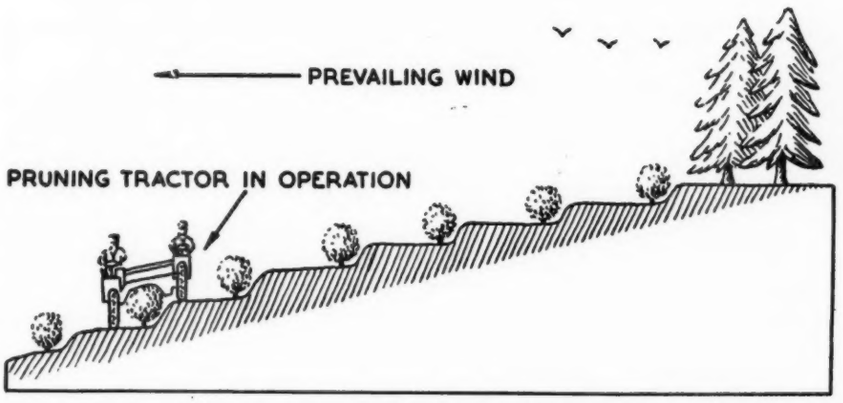
A report comes from Czechoslovakia of a machine for destroying weeds by electricity.

The main feature of the machine is a system of electrodes, one part of which is drawn along the ground among the weeds and the other part of which travels under the surface like the tip of a plough-share. The circuit is 'closed' through the weeds and destroys roots as well as stems. A 1,000–5,000-volt (d.c. or a.c.) supply has been used and the results of tests are stated to be encouraging.

The Russian Tea Industry

M. R. PUNJA

The author of this article recently visited Soviet Russia and other East European countries on an Indian trade delegation



Line-planted tea bushes on a terraced slope in Georgia. The angle of slope is about 16°. The windbreak of evergreen trees is to protect the plantation against winter storms

APPROXIMATELY 97% of the tea produced in the U.S.S.R. is grown in the Black Sea region, where the warm, humid summer and mild winter, with only occasional frosts, is suitable for tea cultivation. Light rainfall is distributed throughout the year.

Before 1917 there were only 1,800 acres under tea, with three primitive factories in Georgia; today the area under tea is 149,000 acres, of which 132,000 acres are in Georgia, 6,000 acres in Krasnodar and 11,000 acres in Azarbaijan. The approximate production of black tea in these Republics is as follows: Georgia, 28,000 tons; Krasnodar, 250 tons; and Azarbaijan, 650 tons – a total of 28,900 tons a year. In addition, about 5,000 to 6,000 tons of brick teas are produced and 6,000 tons of coarse green leaf for the manufacture of caffeine.

Tea is not grown as a single crop, but in conjunction with a number of crops, such as tobacco, citrus and other fruits, and is grown on State and collective farms, on holdings varying from a few acres to 1,000 acres, the leaf being sent to central factories for processing. There are now about 65 of these factories in Georgia, including two brick-tea factories.

Land preparation and planting

For new clearings, jungle is felled and the land cultivated to 25 cm. depth. Soya beans, corn and lupins are cultivated during the first year; in the second year the field is ploughed 25 cm. deep, about 500 lb. per acre superphosphate is applied and the area is lined for planting. Holes 3 to 4 cm. deep are dug at 33 cm. distance and three or four seeds are sown in each, about 150 to 200 kg. of seed being required per ha. of land.

Originally tea seed was imported from Darjeeling, China and Japan. Local research stations have evolved hybrid strains and the country is now self-sufficient for seed. Most of the hybrids are rather small-leaf hybrid China. Tea is grown by hedge method and mainly contour planted at a distance of 1.5 metres* between rows and three bushes per metre in the row, spacing being reduced to 1.25 metres in steeper fields. Seed at stake is the usual practice for planting new clearings, nursery seedlings being used only to fill vacancies.

Pruning

When the plants are three years old they are pruned to 15 to 20 cm. high. In the following year they are pruned to 50 to 60 cm. height, but if the climate is dry the height of pruning is reduced to 35 cm.

Between 15 February and 10 April the bushes are very lightly pruned. Once in 20 years they are hard-pruned to about 12 to 18 in. above ground level. While hard-pruning or 'skiffing' a dome shape is maintained along the plucking line, because the bushes thereby show a larger plucking surface. October or winter pruning is considered bad practice.

Plucking

Plucking commences in the fifth year. The bushes are ready by the beginning of May, when two or three leaves and a bud are plucked. The plucking season extends from May to September, the best tea being produced at the beginning and end of the plucking season. Fine plucking is always resorted to with a strict seven- or eight-day round. Women are employed for plucking and may pluck 20 to 25 lb. per day. A mechanical plucker has been devised and is under test, capable of plucking about 1,000 lb. per day (see WORLD CROPS, 1959, **11**, 12).

Manuring and cultivation

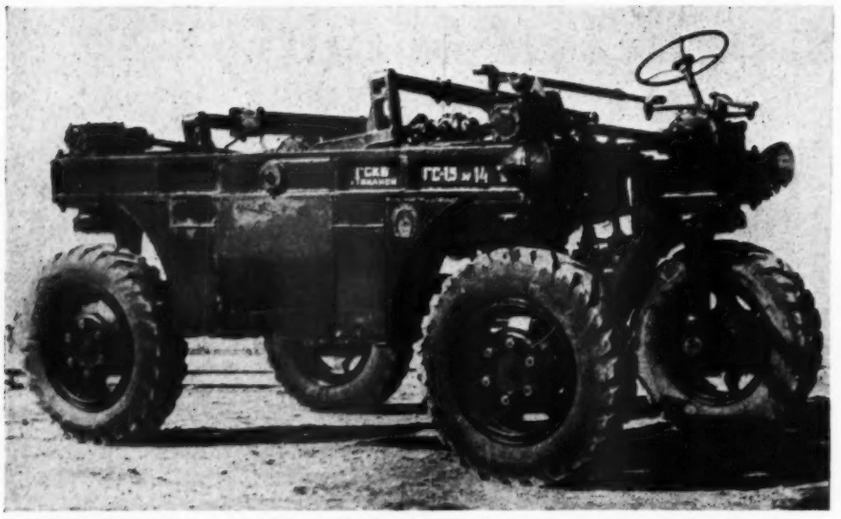
Yields have been appreciably increased during recent years by heavy manuring. Sulphate of ammonia is applied in summer at the rate of 250 to 300 lb. per acre. Superphosphate and muriate of potash at the rate of 150 lb. per acre are applied deep in the soil every year, or four times this quantity once in four years. Cattle manure or compost is also used.

Any type of shade in the tea fields is considered to curb quick growth of flush. Occasionally lupins or crotolaria are seen in weak patches or new clearings. Very little soil cultivation is done, except light hoeing, mainly in winter.

Yields

The average yield is about 500 to 550 lb. of made tea per acre; younger bushes average between 700 and 900 lb. and a few gardens produce as much as 1,200 to 1,500 lb., while the highest yield recorded is just over

* Metre=39 in.; One in.=2.54 cm. hectare or ha.=2.47 acres.



The SSh-24G, a powerful 4-wheel-drive, 30-h.p., slope-compensating tractor

2,000 lb. per acre. These figures are for black tea, made from leaf plucked during five months. Coarse tea, made from leaf plucked for about a month before skiffing, *i.e.* February/March and October, is manufactured into brick teas and caffeine.

Manufacture and grading

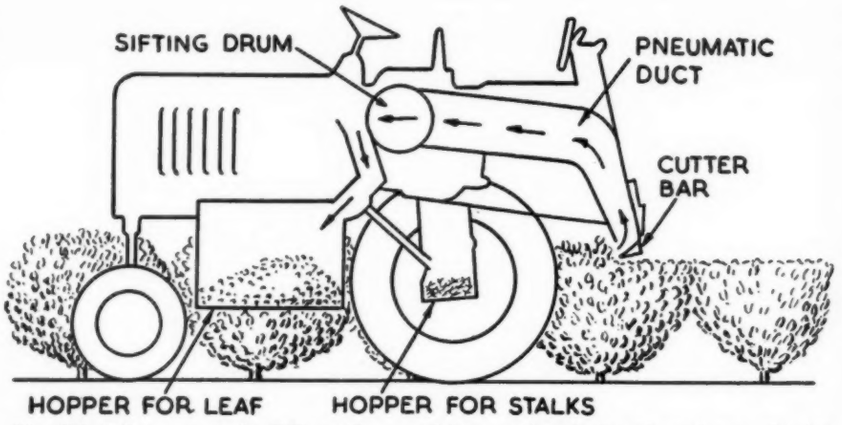
State-owned tea factories are centrally situated, each serving five or six State or collective farms in its vicinity. All operations in manufacture are carried out in the orthodox manner, except that natural withering is avoided. Artificial withering is conducted in large rectangular chambers, the two sides having long rectangular trays with perforated bottoms. Hot air is blown from below up through the trays on which the leaf is spread. Leaf remains on each tray for one hour and is then made to fall to the lower trays.

At the end of seven hours the leaf is considered sufficiently withered. The percentage wither is determined at every stage. Leaf is rolled three times without much pressure, sifted each time and fermented for as long as four hours. Tea is double-fired and grading is similar to that usual in Southern Indian factories.

In every factory there is a tea-mixing drum for blending different grades as required by the packing factories.

Quality

By Indian standards Georgian teas are rather poor, thin liquoring and lacking in quality, but a very high standard of leaf appearance is maintained. With the fine quality of green leaf sent to factories it would be possible to produce very good quality teas by Indian standards, but the deliberate aim here is to produce a thin liquor in teas with flavour by hard rolling and long fermentation, because the Russians prefer thin, light teas, which they drink without milk, but with sugar and a slice of lemon.



Simplified diagram of the SSh-24G as used for pruning hedge-planted tea, showing the flow of trimmings. The machine is a slope-compensating tractor which can work across slopes of up to 30°.

Research work

There are a number of research stations. Two of the main centres of research, established in 1930, are the Anaseoul Research Institute for Subtropical Cultures, where the main studies are concerned with agri-techniques, control of pests and diseases, mechanisation and subtropical economy, and the Central Research Station in Chakwa (Georgia), engaged in selection work. Selection and breeding at the latter centre is confined to Chinese varieties because the big-leaf Assam jāt suffers from frost. Hybrid selections aim to produce high quality and frost resistance. Efforts are being made to raise the percentage of tannin and essential oils in tea.

Future prospects

It is difficult to assess the part which the Russian tea industry may play in the future world tea market. They have appreciably increased production during the past 30 years, but it appears uncertain whether they seek self-sufficiency as regards their tea requirements. Present production represents only 40% of total consumption. Although it is intended to increase this to 60% by 1965, Russia will in all probability continue to buy tea from other countries for some years to come to fill the gap between domestic production and consumption.

An abridged version of an article which appeared in the October 1958 issue of the *Planters' Chronicle*.

Ambassadors of Goodwill

The six young Australian farmers, winners of the 1959 P. & O. 'Canberra' award, have now returned to Australia after a six months' intensive course in the U.K. studying farming methods.

The Ford Foundation and the English Speaking Union have awarded similar travel grants to five British farmers to visit the U.S.A. for eight weeks to travel freely and meet Americans in all walks of life.

Can TEA Replace High FOREST?

A 7-year experiment to ascertain whether high forest can safely be converted into tea plantations without upsetting the water balance, is being made on the slopes of Mt. Sitonen, 7,000 ft. a.s.l., 12 miles from Kericho, the tea-growing centre of Kenya

THE forest reserves of Kenya are not at present open for development because of their vital importance as water catchment areas. Large areas are suitable for tea, but it is not known if high forest can safely be cleared without upsetting the water balance.

Tea, if grown correctly, does not cause any serious deterioration of the soil, and tea bushes provide a good ground cover, but there is one big difference: whereas the forest floor is undisturbed, the inter-row spacing on tea estates is trampled every 10 days by the labourers, thus reducing the capacity of the land to absorb water.

Correct land usage would ensure that a steady flow of water reaches the rivers in dry weather, but there are, unfortunately, parts of East Africa, as in other countries, where forest has been cleared unwisely and instead of this desirable steady flow there is a muddy torrent in the rains and only a miserable trickle during dry spells. Although in the past forest clearing has been a hydrological gamble, water is so important today that land development can no longer be based on guesswork; there must be a proper assessment of the situation before selected areas are turned over to tea.

There are four catchment schemes under way in East Africa and one of these is on the slopes of Mt. Sitonen, near Kericho, the centre of the tea-growing industry, where the conditions in two parallel valleys, each two miles long, are to be compared – one is to be cleared and planted with tea; the forested slopes of the other are not to be disturbed. Great importance is attached to this investigation, as these catchment areas not only supply water for hydro-electric power, but also for thousands of African farmers downstream.

A combined operation

The investigation is to be a combined operation, in which the East African Agriculture and Forestry Research Organisation, the Forestry and Agricultural Departments of Kenya, the Hydraulic Engineer's Branch of the Ministry of Works and experts from the tea industry will participate.

The area has been flown over and the two valleys have been selected by the Deputy Director of the E.A.A.F.R.O., Dr. H. C. Pereira, the Chief Conservator of Forests, Mr. R. R. Waterer, and the Director of the Tea Research Institute, Dr. R. C. Child. A soil survey has been made by Mr. R. M. Scott, soil surveyor, E.A.A.F.R.O., and two 6-ft. concrete weirs have been built to measure the water flow in the two streams, which is at present the same.

A Land Rover in the dense forest where experiments are being carried out to see if the water balance in the catchment areas is affected when tea replaces forest

A central meteorological station has been established, where there are instruments to record hours and intensity of sunshine, atmospheric humidity and evaporation, wind speed and temperature. There are also six 1-acre clearings, arranged over the two adjacent 1,500-acre valleys, with recording rain gauges at ground level and at the top of 100-ft. high satinwood trees. Tensiometers are to be used to determine the moisture content in the soil at varying depths down to 10 ft.

Locally recruited Kipsigis, who have been specially trained, will keep the records and ensure that the forest paths are kept open, and they will work under the supervision of Mr. Ezekiel Kasavali, the senior observer. In this way thousands of measurements will be made to compare the hydrological conditions in the two valleys, and it

African women stake out cleared forest land for planting tea bushes on a terraced area

An African assistant climbs down from the top of a 100-ft. high tree, carrying a plastic pipe connected to a rain gauge

will thus be possible to compare the pattern of the rainstorms with the corresponding pattern of the flow of water in the two rivers.

If this investigation shows that this watershed can safely be opened up for the planting of tea, it will materially assist the economy of the country by attracting overseas capital. At the present time the cost of developing a tea estate, *i.e.* building roads and dams, labour lines and a factory, and planting the tea, costs £600 per acre.

A plastic tube being cut to fit into a recording jar at the base of the tree, in the top of which is a rain gauge

Changing Influences in Canada

The Canadian agricultural scene is an ever-changing one, subject as it is to the vagaries of nature, the shifting of markets and the response of the farming community to governmental assistance. Throughout the post-war years a surplus of wheat has persisted as a particularly intractable problem. This year mounting stocks of certain livestock and dairy products have emerged as further complicating factors. In addition, the Federal Government has lowered some of its support prices and in doing so has endeavoured to reshape its support policy so that the benefits will accrue mainly to the small farmer.

In August 1958 the Government had concluded, after careful consideration, that deficiency payments would not in the long run be in the interest of either the grain producers or of the nation as a whole.

The current position of Canadian wheat, however, is not discouraging. On 1 August, 1958, the beginning of the current crop year, the carry-over was 612 million bushels, some 118 million less than a year earlier. Last autumn's crop of 369 million bushels, only slightly less than a year earlier, brought total available supplies to 980 million bushels, a decline of 11% from the preceding year.

Longer - term concern regarding wheat relates to the world situation. In the face of shrinking commercial import demand, exportable world supplies are currently the highest on record. In early March this year supplies of wheat available for export and carry-over in the four major wheat-exporting countries – Canada, U.S.A., Australia and Argentina – amounted to 2,400 million bushels, some 450 million more than a year earlier. World exports of wheat and wheat flour are expected to approximate 1,200 million bushels, only 50 million more than last year. Moreover, Spain and Turkey, whose wheat has been virtually absent from world markets for several years, are now substantial exporters.

Some alteration in world wheat trading conditions is, however, foreshadowed in the new International Wheat Agreement, which became operative on 31 July, 1959, and now includes the U.K. An important difference in the operation of the new agreement will be that importing nations, instead of designating specific quantities to be taken from individual exporting countries, will agree to import, from I.W.A. exporters as a whole, a prescribed percentage of the wheat they will use each year.

High-speed Handling

The new marine grain terminal at Los Angeles Harbour will be geared to load 500 tons (17,000 bushels) or unload 300 tons (10,200 bushels) an hour. Wheat, barley, milo, alfalfa pellets and other grains from the south-western part of the U.S.A. will be shipped to Far and Near East ports, mainly in Japan and India. Imports will consist mostly of copra meal and copra cake from the Philippines.

The Harbour Department is to spend $160,000 in installing a quarter-mile trough-belt conveyor system, a 6-ton gantry crane and a 65 ft. high bucket elevator.

Future plans include the installation of an automatic truck dumper, which will tilt big transport lorries up in the air, depositing whole truckloads at a time into the conveyor system.

Wind Power

To supply electric power for isolated farms and rural houses a wind-driven generator can be a satisfactory and economic proposition if the site is reasonably windy. But it is essential that all the energy becoming available at random times shall be put to good use.

The E.R.A. wind power section has been carrying out experiments at a remote station in the Cairngorms in Scotland and the results obtained so far have been quite encouraging. During the month of December the 8-kW wind-power plant gave an output of 1,080 kWh for a monthly average wind speed of 12 to 13 m.p.h. The diesel-electric set, which was installed as a safeguard against complete failure of supply during the initial test period, was called upon to provide only 17 kWh in the month.

Chemical Taints in Arabica Coffee

J. A. N. WALLIS *

In view of the variety and quantity of agricultural chemicals now being used by coffee growers in all parts of the world, taint is clearly a most important matter for consideration.

Photo: East African Information Office.

Kikuyu girls picking coffee on a plantation near Nairobi

SOME of the finest mild coffee in the world is produced in Kenya and at present it fetches prices considerably higher than most other coffees. In order to increase coffee production and to protect the plantations from the depredations of pests and diseases, more and more agricultural chemicals are being used by coffee growers in Kenya, but in the light of experience, great care is now being taken to ensure that none of the chemicals used shall taint the liquor and so reduce the demand for this exceptionally fine coffee.

For the past nine years trials with various chemicals have been carried out by members of the Coffee Research Station, Ruiru, to determine whether or not any of these new materials are capable of inducing taints in the coffee liquor.[1] The usual procedure is to treat groups of coffee trees with the maximum concentration of chemical likely to be used by the industry.

Liquid insecticides are usually applied to the foliage at the rate of about a pint of spray fluid per tree, though in the case of chemicals to be used for the control of white borer, *Anthores leuconotus*, or against ants attendant upon the coffee mealybug, *Planococcus kenyae*, the sprays are only applied to the bottom 2 ft. of the main stem. Herbicides are, of course, only sprayed on the area between coffee trees. These trials are fully replicated.

Samples of coffee cherry are picked on several occasions each season and are processed according to the 'wet' method standard to the Kenya coffee industry. When the parchment samples are dry, they are submitted to the liquorer of the Coffee Board of Kenya, Mr. C. R. Devonshire, for cup testing. While many members of the staff of the Coffee Research Station have been responsible for the taint trials, Mr. Devonshire has liquored all the coffee samples from the numerous experiments, which would have been worthless without his active co-operation.

Insecticides

'Bricky' flavour

In 1950, BHC insecticides became readily available on the East African market and were recommended for use as sprays against Antestia, *Antestiopsis* spp., and powder formulations for soil and stem application against the Pheidole ant, *Pheidole punctulata*, which attends mealybugs and scale insects.

About halfway through the 1950 picking season it was suggested that, since it had been established that the use of BHC had led to a 'musty' taint in papaws, cabbages and beans, there was a danger that its use on coffee might also produce an off-flavour. At about the same time the Coffee Board liquorer remarked on the sudden occurrence of 'bricky' flavour in some consignments of Kenya coffee. He stated that this was the first time he had found this type of flavour in Kenya coffee, although he had encountered it previously in certain hard Brazilian coffees.

In late 1950, an enquiry was made which revealed that all the 72 estates which had produced out-turns with a 'bricky' flavour had used BHC in one form or another. It appeared that BHC sprays were most frequently associated with the taint, but a powder formulation applied to the ground was also associated with 'bricky' flavour.[2]

The evidence against BHC was so great that in April 1951 the Coffee Research Station had to withdraw its recommendation for the use on coffee plantations of all insecticides containing BHC. However, research was carried out to determine if deodorised formulations and very pure gamma isomers of BHC might be used without tainting the coffee. Unfortunately, it was discovered that all the BHC formulations tested led to a 'bricky' flavour in the liquor.

In view of the serious nature of this taint, it was considered that no risks should be taken which might undermine the good reputation of Kenya coffee, so since 1951 the official policy has been that no BHC should be used on coffee plantations. Today 'bricky'

* Agricultural Officer, Investigations, Coffee Research Station, Kenya

flavour is almost unknown in Kenya coffee and the occasional case in which an out-turn is given this description can usually be traced back to the use of sacks contaminated with BHC or even, as in one case, to the use of a cattle dip formulation as an insecticidal spray for coffee trees.

In view of conclusive experimental and circumstantial evidence of the relationship of BHC use on coffee with the presence of a ' bricky ' flavour in the liquor it seems strange that in all coffee-growing countries, other than Kenya, this association is either disbelieved or ignored, or possibly confused with some other taint.

Indefinable taints

Following the experience with BHC described above, very great care has been taken in Kenya to ensure that other chemicals recommended for use on coffee will not taint the coffee liquor.

Fortunately, none of the insecticides which has been tested has produced distinct taints in the coffee liquor, but, as Table 1 shows, nine chemicals have been associated with ill-defined taints on one or more occasions. Tests will continue with those insecticides considered to be of value to coffee growers, but it must be realised that the case against these is definitely ' not proven '.

It is most unlikely that such insecticides as dieldrin, malathion and diazinon produce serious taints, since all three have been used extensively on Kenya coffee plantations for several years and no new off-flavour has been reported by the Coffee Board liquorer during this period.

Herbicides

' Bricky ' flavour

Although various chemicals and techniques for weed control in coffee had been tried out prior to 1954, it was not until that year that a fully replicated herbicide trial was laid out in the coffee at the Coffee Research Station, Ruiru. The principal chemical treatment in this trial was 5 gal. per acre of an oil emulsion containing 2½ lb. PCP. This was applied with or without 1 lb. a.e. per acre of 2,4-dichlorophenoxyacetic acid as the amine salt – 2,4-D(amine). Dalapon at 5 lb. per acre with 1 lb. a.e. 2,4-D amine and a hand weeding treatment was also included.

In 1954 yields were low and no taints were detected in any of the samples of coffee which were taken from each plot. However, in similar samples submitted from the heavy 1955 crop a distinct ' bricky ' flavour was detected in the coffee from plots treated with PCP. No taint was reported in the 1956 samples, which were from a light crop, and the coffee from the first half of the heavy 1957 crop was also free of off-flavours, but 'bricky' flavour was again reported in one of the last pickings of the 1957 season, and once more it was closely associated with the use of PCP.[3, 4]

The evidence against the use of

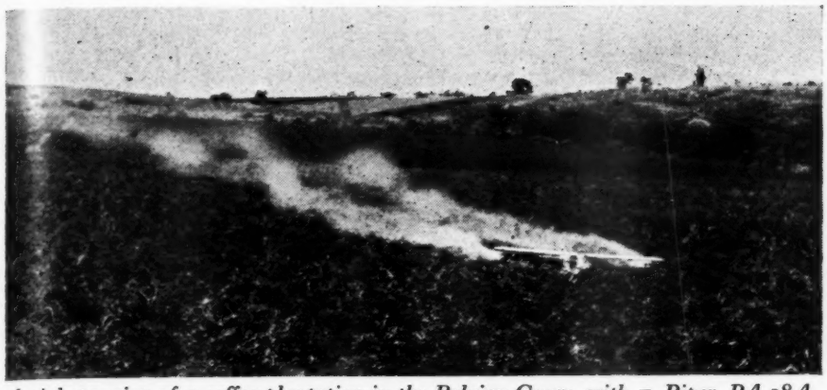
Table 1—Insecticides

A summary of results from coffee liquor tests

Tested, but no record of any taint		*One or more records of indefinable taints*		*Distinct taints*		
Chemical	*Max. strength*	*Chemical*	*Max. strength*	*Chemical*		*Taint*
				% gamma isomer		
Endrin, 19% EC ..	1/500	Dieldrin, 19% EC ..	1/9			
Isodrin, 18% EC ..	1/500	Malathion, 50% EC ..	1/320	BHC dust ..	0.65	'Bricky'
Chlordane, 75% EC ..	1/500	Parathion, 50% EC ..	1/500	BHC dust ..	2.60	,,
Metasystox, 50% EC ..	1/500	Diazinon, 60%EC ..	1/640	BHC, WP ..	6.50	,,
Pyrethrum, 6%		Chlorothion, 50% EC ..		BHC, EC ..	10.00	,,
		Phosphamidon, 20% EC	1/400	BHC, EC ..	20.00	,,
		Dimefox, 20% EC ..				
		Rogor, 45% EC.. ..	1/200			
		Toxaphene, 50% EC ..	1/300			
		Sevin, 50% WP.. ..	1/500			

Table 2—Herbicides

Tested, but no record of any taint		*One or more records of indefinable taints (active ingredient in 80 g.p.a.)*		*Distinct taints*	
Chemical	*Max. strength*	*Chemical*	*Max. strength*	*Chemical*	*Taint*
Aminotriazole	5.0 lb.	Dalapon	8.0 lb.	PCP	'Bricky'
Simazin	8.0 ,,	2,4-Des. (as Sesone) ..	8.0 ,,	CMPP	'Buni'
Monuron	3.2 ,,				
MH	8.0 ,,				
2,4-D	1.3 ,,				
2,4,5-T	1.0 ,,				
MCPA	1.3 ,,				



Aerial spraying of a coffee plantation in the Belgian Congo with a Piper PA 18A, using Endrin insecticide in gasoil

PCP in coffee has been derived entirely from one fully replicated trial, from which numerous samples of coffee were liquored in each of the four seasons it was in progress. From this it is clear that, if Kenya coffee is to retain its good reputation, PCP cannot be recommended for use in Kenya coffee plantations, although in Hawaii it is considered satisfactory and it is recommended for use in several Central and South American coffee-growing countries.[5]

'Buni' flavour

For the past two seasons (1957 and 1958) numerous coffee samples have been liquored from the herbicide observation plots at the Coffee Research Station, Ruiru, but only in the case of d1-2-(4 chloro-2-methyl phenoxy) propionic acid (CMPP) has a taint been defined. The liquorer has described it as a 'buni type flavour' on each occasion he has received samples from plots treated with CMPP.

Slight taints have been reported in two out of the six samples submitted from the plots treated with sodium 2,4 - dichlorophenoxyethyl sulphate (2,4-Des) and slight unidentified taints have also been recorded in three out of the 24 samples from plots treated with dalapon alone[1] (see Table 2). Although it is by no means certain that these slight taints have, in fact, been caused by the herbicides, the occurrence of a single report of a taint serves as a warning that the chemical must be tested on many more occasions before being recommended for general use.

Fungicides and Fertilisers

So far samples have not been submitted from fungicide trials, which have usually included only copper formulations; recently a wide range of chemicals has come under test and from these new trials coffee samples will be taken for liquoring.

Coffee samples from fertiliser trials have been liquored for many years, but in no case has there been any report of a taint.

Other taints

Occasionally a liquor report includes the description 'carbolic', which is thought to be caused by contamination with disinfectants or with certain emulsions used in the manufacture of sacks.[6] This is one of the taints described fully by Milton.[7]

During the survey to investigate the relationship between BHC and 'bricky' flavour, enquiries were made to determine whether a similar connection could be established between 'onion' flavour and any agricultural chemical. Neither at that time nor subsequently has there been any indication that 'onion' flavour is anything but a biological problem.[8, 9, 10]

'Grassy' flavour has caused much trouble in the Belgian Congo, where it is described as 'Le gout de pomme de terre', but in Kenya it is quite rare. Recent work by Fassi at Yangambi, Belgian Congo, appears to have established that this taint is associated with the decomposition of bacteria which invade the pulp (mesocarp) around the coffee beans while the coffee is still on the tree.[11] There is again no indication that this taint is caused by agricultural chemicals.

Discussion

One of the principal difficulties with this work on chemical taints in coffee is that they do not invariably occur, so that, while the presence of a distinct taint gives a clear indication of the hazard, a sample described as 'free of off-flavours' does not entitle one to state that the particular chemical used will never produce a taint in coffee.

The example of PCP, described above, is a case in point. In the first and third years of the trial, when the level of cropping was low, no taint was detected in the samples, but 'bricky' flavour was very distinct in the other two years of the trial, when the only difference in the coffee appeared in the yield.

Since it is intended that no chemicals which might cause taints in the coffee liquor shall be recommended for use by coffee growers, it is evident that in parallel with investigations on the effect of chemicals as insecticides, fungicides or herbicides liquor samples must be taken throughout at least two cropping seasons and then, after a new chemical has been in general use for a season, reports of new taints in outturns should be investigated.

REFERENCES

1. Anon., Experimental files, Coffee Research Station, Ruiru, Kenya.
2. Rayner, R. W. (1951b), 'Bricky Flavour', *Mon. Bull. Coffee Bd. Kenya*, **16**, 90.
3. Robinson, J. B. D. (1956), 'Recent Results of Experiments with Weedkillers', *Mon. Bull. Coffee Bd. Kenya*, **21**, 240.
4. Wallis, J. A. N. (1958), 'Herbicides in Kenya Coffee', *Pesticides Abstracts and News Summary*, Sect. C, **4**, 146.
5. Robinson, J. B. D. (1958), 'Chemical Weed Control in Coffee', *Coffee and Tea Industries*, **81/11**, 100.
6. Devonshire, C. R. (1956), 'Explanation of the Coffee Report Form', *Mon. Bull. Coffee Bd. Kenya*, **21**, 186.
7. Milton, R. F. (1956), *Damage to Coffee by Taints*, United Kingdom Mutual Steamship Assurance Association Ltd., London.
8. Jones, P. A., and Devonshire, C. R. (1956), 'A Note on Onion Flavour', *Mon. Bull. Coffee Bd. Kenya*, **21**, 157.
9. Rayner, R. W. (1950), 'Quality and Onion Flavour', *Mon. Bull. Coffee Bd. Kenya*, **15**, 324.
10. Rayner, R. W. (1951a), 'A Note on Onion Flavour', *Mon. Bull. Coffee Bd. Kenya*, **16**, 60.
11. Fassi, M. (1957), *Rapport d'une inspection phytosanitaire efectuee au Kivu 20/2 au 11/3/57*. Circulated typescript from Institute National pour l'etude Agronomique du Congo Belge.

Experimental Garden in Western Samoa

Tea plants from Assam, new kinds of taro root from the southern States of America, pigeon peas from Fiji, 'dry land' rice from Malaya, new types of cocoa from Trinidad and New Guinea, cola plants, nutmeg, black pepper and high-producing fodder grasses are flourishing on a 16-acre experimental farm operated by the Department of Agriculture in Western Samoa. Three years ago the area was a jungle of bush trees and wild mimosa.

Demonstrations of manuring, grafting and pruning have been set up, with control plots as a comparison, and a citrus nursery is being developed.

Quick-Growing Timber

From seedling to tree in six years. A 70 ft. eucalyptus tree falling to the axe

EAST AFRICA is not producing enough timber for domestic consumption and it is rare to find a farm which is not dependent for fuel and timber on outside supplies. Most Kenya industries need wood fuel—tea drying needs wood; pyrethrum needs fuel to dry it; tobacco needs fuel for curing; fuel is needed for the firing of bricks; and mining needs pit props.

The principle that every farm should be self-supporting in timber is now being recommended by the East African Agriculture and Forestry Research Organisation, because on most farms there is land which, though not suitable for farming, will grow trees.

The Organisation is now carrying out research on its 1,600-acre estate at Muguga, 7,000 ft. up, astride the Equator. When the estate was taken over in 1950, to be opened up for agriculture and forestry research it was mostly covered with wattle. It was quickly appreciated that once this supply of fuel was used up, it would be difficult to obtain further supplies. Accordingly in 1952, a trial plantation of 10,000 gum trees of the variety, *Eucalyptus saligna* was established by the silviculturist, Dr. H. A. Griffith.

In temperate climates, these trees take from 50 to 75 years to mature, but in the clear, tropical sunshine and rarified mountain air, its life cycle is only six years. This year when they were 70 ft. high they were harvested and the 20 acre trial plantation produced 11,100 poles, equal to 34,000 cu. ft. of timber, each tree weighing between 400 and 500 lb.

The trees are trimmed and stacked for use as domestic fuel by the scientific staff and the labour force and also to provide small timber for building construction; the wood chips are distilled in retorts to obtain gas for use in the laboratories and a preservative wood oil is produced as a by-product.

Photos: East Africa High Commission

An African forester trimming the branches from a 6-year-old tree in the Muguga fuel forest

Arsenic on the Farm

During September farmers will be lifting potatoes and some may decide to use arsenical sprays to kill off haulm and weeds; these sprays are highly toxic to all animals and if it is considered absolutely essential to use them the greatest care must be taken. Before spraying, field fences must be made stockproof and livestock moved from down-wind fields. Electric fences alone cannot be relied upon to keep out determined and inquisitive cattle. While spraying is in progress no unprotected person should be allowed in the field. Spray drift from any chemical spray is a nuisance, but drift from an arsenical spray is dangerous, so spraying should be done only in calm weather. After spraying, gates of fields of treated crops should be securely fastened and warning notices erected. Stock should be kept out of treated fields until the treated haulm and weeds have been completely burned in small heaps throughout the field. If this is impossible, at least six weeks should be allowed after spraying before letting stock into the field.

Used containers should be washed out, punctured to prevent further use and disposed of safely, *e.g.* by burying or burning. Arsenical sprays must never be used on any edible crop other than potatoes.

The Biology of Tropical Soils

PROF. J. KEILLING*

FROM the bacteriological point of view, the differences between soils in the rainy tropics and those in temperate climates are as follows: (1) throughout most of the year they are at a high temperature, 25°– 28°C, or *circa* 80°F, (2) the rainy seasons, though shorter than the dry periods, are characterised by very hard and prolonged downpours, and (3) there is usually a very long season of almost complete drought.

Humus disappears like snow

These high temperatures increase the rate of soil fermentation, which means that the resultant build-up of decomposition products to form humus is more rapid than in colder climates. Unfortunately, the next step is also more rapid, for this humus is quickly broken down into more or less inert mineral residues. Only those tropical soils which are covered by abundant vegetation, which gives shade and conserves moisture all through the year, can provide conditions in which the humus can accumulate.

On more exposed soils heavy and prolonged rain washes away much soluble matter and rapidly impoverishes the soil, and prolonged heat and drought will halt the multiplication of bacteria and reduce the population of surface microflora.

This is a very different situation from that obtaining in temperate regions, where the fermentation of organic matter is slow in summer, and even slower in winter. On the other hand, severe storms are comparatively rare and there is usually little soil damage from this cause.

Role of microflora

Investigations of the role of bacteria and other micro-organisms in the growth of plants indicate the need for continuous proliferation of bacteria during the period of plant growth and lead to the conclusion that a crop grower must be something of a bacteriologist and encourage the soil microflora, which are so essential for fertility.

Photo: Malayan Information Agency.

A giant jelutong tree, Dyera costulate, *which is tapped to obtain latex for making chewing gum. Note the surface litter of leaves and twigs which produce the mat of humus in tropical jungles*

Part of the work of this soil population has long been known: the nitrogen fixation, the humus formation, the conversion of nitrites to nitrates, and of insoluble salts to their soluble counterparts, the building up of soil aggregate, and the release of carbon dioxide. There has also been much research done on the way bacteria break down organic matter and much importance is attached to counts of soil bacteria. But now another important aspect is being studied. This is the production in the soil of growth substances – the auxins and the vitamins – now known to be products of microbiological activity.

Application of organic matter

Thus it is not only necessary to take into account the simple and well-understood functions of the soil microflora, but also the production of growth-promoting substances and the correct timing of their appearance in the root systems of the plants. There are three possibilities:

(1) Introducing bulky organic matter into the soil and leaving it there to ferment, subject to the accelerations and slowing-down processes of nature in a tropical climate and to the leaching effect of tropical rains.

(2) The same material could be composted in a heap, independently of soil conditions. This can be done under ideal conditions with shade and moisture as necessary, and the process can be accelerated or retarded by aeration or the reverse, and by turning, or not turning, the heaps. By such control the end-product can be made available when needed.

(3) Between these two there is a third method. This is to use a 'mulch' of organic material which will gradually be broken down and incorporated in the soil with, of course, the same disabilities as the first method.

From the bacteriological point of view alone, the second method is by far the best. Not only is it controlled, but the high temperatures which are reached during the composting process give almost total security against pests and disease organisms. However, the labour involved in collecting and transporting the bulky organic material and the incorporation of the compost into the soil is considerable. The normal practice is therefore either to neglect to restore the organic matter or to put on only such vegetation as is available on site.

Such neglect results in soil degradation, leading to infertility, and if

* Formerly Professor at the Institute of Agronomy of France and Director of the National Centre for Agricultural Microbiological Research and now President of the French Society for Agricultural Research.

uncomposted material is applied to such a soil it may be useless because the bacterial population is insufficient to break it down.

Use of starters

After a hot and dry spell the soil will be low in soil microflora and the organic matter applied will, unless previously composted, be in the same condition. This being so, the remedy is to put in starters, such as compost or 'Cofuna',* a farmyard manure substitute, but, of course, only relatively small quantities are needed, but enough must be put on and as often as is necessary to activate the main bulk of applied organic material.

The grower must decide the best time to apply the 'starter' before the incorporation of the trash. If organic matter is incorporated at the end of the dry season, bacterial proliferation will be slow because of the low soil moisture. The opposite is the case if he waits until the rains have started. If possible, it is better to incorporate the 'starter' several times during the season so that the bacterial population will be maintained.

This tackling of agricultural problems from the bacteriological point of view does not mean that we should pay less attention to, or forget the importance of, fertilisers, but by paying more attention to the microbial aspect we shall be better able to overcome practical difficulties and understand phenomena which so often arise, but so far remain unexplained.

* 'Cofuna' – see WORLD CROPS, 1959, 11, 77.

Diagnosis of Deficiency

The most common mineral deficiencies in Malayan soils, on which rubber is grown, are nitrogen, phosphorus, potash, magnesium and, in certain areas, manganese, according to the *Planters Bulletin* of the Rubber Research Institute of Malaya, May 1959.

The foliar symptoms of magnesium and manganese deficiency are as follows: when magnesium is lacking, the chlorotic areas spread between the veins from the margins of the leaf inwards; manganese deficiency produces an overall paling with bands of green tissue outlining the midribs and lateral veins. This has been confirmed by analysis.

The Cereal Testing Section is one of the controlled condition rooms at the Official Seed Testing Station

Britain's Official Seed Testing Station

Founded almost 40 years ago to implement the conditions of the Seeds Act, 1920, the Official Seed Testing Station of the U.K. recently moved into new laboratories and administration offices adjoining its old premises in the National Institute of Agricultural Botany at Cambridge.

Every year thousands of seed samples are sent to the station from seed merchants and commercial growers in all parts of England and Wales. They include cereals and pulses, vegetables, clovers and grasses. The samples are analysed first for purity and weed seeds and are then tested for germination so that the seller can make the declaration required by the Act.

The new three-story building houses laboratories modelled on those used successfully for some years in the Dutch seed testing station. A great deal of attention has been paid to window lighting and colour schemes as ideal conditions are required for the exacting task of separating and identifying seeds and foreign matter.

The germination tests have to be made under carefully controlled conditions and in three of the station's sections, special rooms are set aside for this purpose. A number of seeds from each sample are selected at random and planted in aluminium pots filled with wet sand. These are then stored for a set period in the controlled rooms and examined at regular intervals.

The weight of the sand-filled pots – sometimes as many as 2,000 are being used for tests at the same time – presented something of a storage problem to the designers of the new station. This was overcome by the use of the 'Spur' adjustable shelving system, made by Savage and Parsons Ltd. Their strength and flexibility are ideal for laboratory use, as the shelves can be adjusted rapidly to any height.

In the Cereal Testing Section, which is the largest in the station, a temperature-controlled room is lined with chipboard shelving which is carried on 14½-in. brackets supported on wall-mounted uprights. Additional banks of shelves are provided by double-sided uprights, which are fixed between floor and ceiling to form a projecting wing. On these, wheat, barley, oats, corn and rye are tested for germination properties.

In the Root Testing Section a 'hot' room for testing beet seeds uses wooden slatted shelves supported by 14½-in. brackets. These are fitted into wall-mounted uprights, and allow the humidified air to circulate around the pots and give the required conditions. A similar type of shelving is used in the section where peas and beans are tested.

Agricultural Training for the Blind

SUSAN LESTER

Commonwealth countries have about three million blind people. India and Pakistan have two million; Calcutta alone has as many as the whole of Canada, and the terrible fact remains that two-thirds of all this blindness is preventable

THE causes of blindness are manifold, varying with the particular conditions in the territory concerned, but a sad factor, common to all, is the acceptance of blind people as an inevitable burden on their families or on the community, with begging as their only means of livelihood.

This is the situation which the Royal Commonwealth Society for the Blind and its associated organisation in 25 territories is determined to remedy, but it is not an easy task. Teams of experts, working in remote and sometimes less accessible parts of the Commonwealth, have to fight local conditions and local suspicion and to take a census, examine the causes and instigate remedies for blindness in the locality. Usually there is excellent co-operation from the Government, the local blind welfare associations and other voluntary bodies, but where this is absent the work becomes pioneer in every sense.

Causes of blindness

The causes of blindness are, broadly, *trachoma* – which can be remedied by modern drugs – malnutrition, superstitious practices, leprosy and smallpox. Even measles and conjunctivitis can cause blindness among people who do not understand elementary hygiene or where lack of water discourages washing. Some of the locally invented treatments, too, have no scientific basis and can blind quite unnecessarily. Dust and flies play havoc with sight in areas with dusty roads and with no means of controlling flies and other insects.

In West Africa *onchocerciasis*, or river blindness, caused by the bite of the dreaded simulium fly, has been the subject of a four-year survey promoted by the R.C.S.B., and the Ghana Government is now working on its control, for the disease can now be checked by medical treatment before causing incurable blindness.

Three blind trainees extracting fibre from retted material for use in their workshop. The cleaned fibre can be seen being sun-dried on lines in the background

Left:
Two blind Nigerians building a compost heap made principally of grass which they have cut in the neighbouring fields. The finished compost is used in their vegetable gardens

In the Eastern States of Malaya – a country which has an estimated figure of 15,000 blind – blindness in children frequently results from *keratomalacia*, caused by vitamin deficiency. Shortly after weaning children are put on a diet of polished rice, which is deficient in a number of vitamins, principally B_1 and B_2. There are ample foods available with the necessary vitamins in the rural areas, but

A blind man weeding maize

they do not reach the children. This, then, is not so much a medical as a social problem.

Rural training schemes

One of the most acceptable means of training adult blind people is the establishment of rural training schemes with the object of incorporating them into useful local employment.

This is a gigantic task, for it will take years to impress its importance, not only on local officials, but also on blind people themselves and the communities from which they come.

Uganda and Tanganyika

In training blind people at these rural centres, it is first of all necessary to create a feeling of independence and self-respect before their introduction to craft training and crop cultivation, which makes them suitable as employees or as farmers in their own right. Looking now at similar schemes in Uganda (promoted by the local Foundation for the Blind, with international help) and at Tabora in Tanganyika, which have 37,000 and 50,000 blind respectively, it is most encouraging to see trainees clearing scrub land, extracting deep roots, planting crops, shading and thinning them, weeding and tending them up to harvesting. The present crops are cotton, sorghum, sweet potatoes, cassava (tapioca), onions, spinach and peas. Next season they are putting down matoke, groundnuts, beans and maize, as well as coffee and beans.

Naturally, the numbers of successful trainees are as yet only small, for accommodation seldom exceeds 30 people at a time, and there is a waiting list at more than one centre. In Uganda the local foundation successfully trained 24 farmers, aged between 21 and 35, in 18 months.

Nigeria

In Nigeria, where there are 312,000 blind, the Nigeria Farmcraft Centre at Ikeja which the R.C.S.B. was asked by the Federal Government to establish, is one successful instance of utilising blind labour. Some 63 acres of valuable farming land at Ikeja airport was leased by the Government to the Society at a nominal rent and the Government also made a grant to the Society of £10,000 – the estimated cost of the buildings, furniture, tools and equipment. Initially the plan is for blind people from rural areas whose families own land.

Under the guidance of trained staff, the trainees are first taught independence of movement around the centre and familiarity with the equipment. Later they are taught land clearance, starting with virgin bush, stumping and levelling and then digging, composting, planting and harvesting, in addition to animal husbandry, crop rotation and making such village craft products as are likely to find a market. Finally, the trainees are taught to recognise good and bad quality in their produce by feel and smell. Initially yam, papaya, cassava, early maize and dry-season vegetables were sown.

The training lasts for one year and an after-care officer, an intrepid expert, recruited by the R.C.S.B. from Lancashire, returns with the trainees to their home village to ensure their proper resettlement. Obviously, when numbers increase resettlement will only be satisfactory if local authorities and the families co-operate. It is particularly important, of course, to ensure that blind farmers have access to regular advice and supplies of seeds and other planting materials.

Kenya

Kenya has about 65,000 blind and a third of these are children and young people of working age. Assuming that the cost to their families or the community is only £10 annually for each individual, they together represent an economic burden of at least £65,000 annually. But the estimated cost of training a blind man to be largely self-supporting as a *shamba** cultivator is less than the cost of maintaining him in idleness for four years. An important feature of the rural training scheme at Malakisi in Kenya, administered by the Salvation Army, is that its cost has been kept down to a figure which is within the resources of any community in Africa. Moreover, the scheme, though initially planned by experts, is administered by staff who, though very knowledgeable about the country and its agricultural practices, had no previous experience in training the blind.

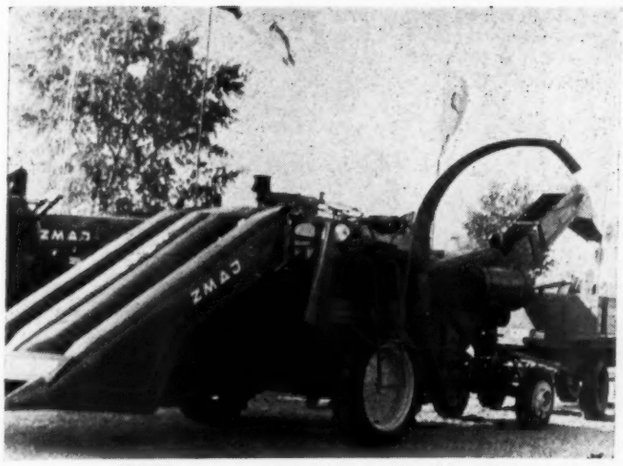
Nyasaland

A similar scheme, though costing £3,500, is in operation at Mlanje in Nyasaland, where the Society's representative has met with some suspicion and hostility towards his efforts. Here the problem of after-care is more pressing. Without this all such training is useless and this aspect of the work requires much persistent effort.

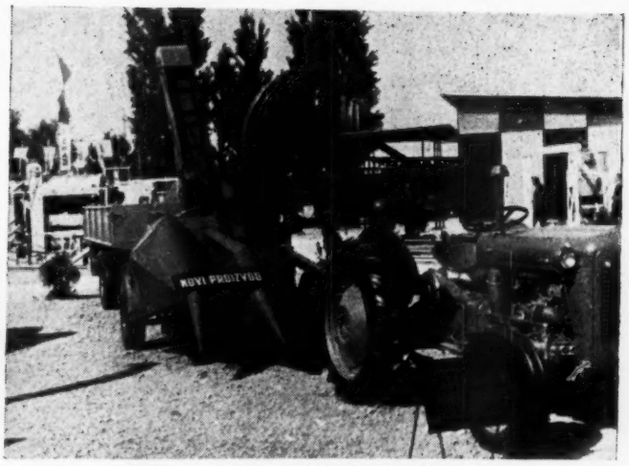
Summary

A start is being made to integrate blind people into the normal life of the community. Experience has shown that they can be made into successful farmers and craftsmen; moreover, they can be successful, self-respecting citizens and as able as the next to help to shoulder the economic burden of their countries.

* Shamba: smallholding



SKK-2, two-row maize combine harvester



BK-1, one-row maize combine harvester

East Meets West

Interesting New Machines at Novisad Exposition

The Iron Curtain is gradually rising. Twenty-one countries, ranging from the U.S.S.R. to the U.S.A., from the U.K. to Austria and from Israel to Japan, were represented at the Yugoslav Agricultural Exposition

AT the Novisad Agricultural Exposition in Yugoslavia many East European agricultural machines, some of which have previously been described in WORLD CROPS, were shown, together with a large number of new machines, many of them prototypes not yet in regular production.

The *U.S.S.R.* exhibited a new seed-sowing machine – the 'Vilmo' – three of which can be drawn as a gang behind a tractor. This gives greater width of operation in the field; the two outer units can be folded back for movement on the road.

Sweden showed the 'Hilleshog' sugar-beet harvester and a nine-row sowing machine; the latter has a reciprocating mechanism consisting of a rubber belt perforated with holes, through which one seed passes at a time. *Finland* had a neat little harvester thresher, the 'Sampo' 657 LP, which has a cutting width of 6 ft. and is powered by a 28-h.p. Volkswagen engine. *Austria* exhibited the 'Alfa' silo combine and a number of implements.

Machinery for maize

The show was not unnaturally dominated by machinery used for the sowing, harvesting and cultivation of maize, the principal crop in *Yugoslavia*, where agricultural research institutes have for some time been developing suitable machines in collaboration with British and Italian manufacturers.

Their harvesting machines are of two types: a one-row machine, the BK-1, and a two-row combine, the SKK-2, both being produced at the Zmaj works under licence from Massey-Ferguson.

The former cuts the corn, removes and breaks up the ears, delivers the grain into an accompanying trailer and broadcasts the chopped stalks over the land. The machine, which weighs 3,300 lb., is very flexible and can be drawn behind a 35-h.p. tractor at from 2 to 5 m.p.h.

The two-row machine is an interesting cross between British and East European design. The engine, transmission and frame were built in the country under licence from Massey-Ferguson and the stalk-cutting, chopping, and ear-breaking mechanism was based on East European practice.

The machine is designed for row spacings from 27 to 36 in.; it is about 27 ft. long, weighs about $4\frac{1}{2}$ tons and has a 62-h.p. Perkins engine. It can harvest about one acre an hour.

There was a prototype three-row harvester, based on American design, and fore-mounted on a Ferguson 35 tractor, which is now under trial. The machine is designed for 3-ft. row spacings only.

A stationary thresher, a low-cost machine which is greatly in demand, was also shown. The design of this machine is based on that of the mobile harvester threshers.

Other implements and tractors

Many implements were exhibited for soil cultivation: some deep ploughs from *Italy*; the Howard 'Rotavator' as built under licence at a Yugoslav works. A *Hungarian* portable winch of 7 h.p. for the cultivation of vineyards was seen, together with many other implements. Hungary also exhibited an oil-heated, electrically-powered grain drier, the 'Farmer'.

The Industria Motora Rakovitza works in *Yugoslavia* is now producing Ferguson tractors fitted with Perkins engines, which are imported.

Sodium — an Essential Element

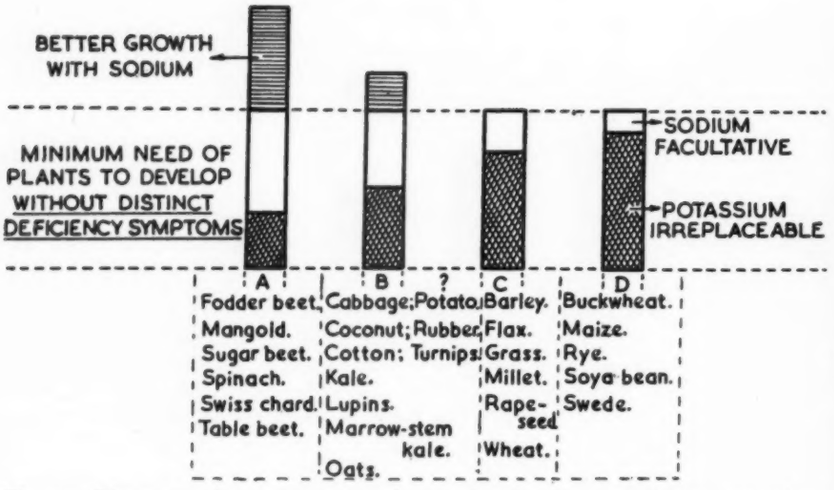

BETTER GROWTH WITH SODIUM
MINIMUM NEED OF PLANTS TO DEVELOP WITHOUT DISTINCT DEFICIENCY SYMPTOMS
SODIUM FACULTATIVE
POTASSIUM IRREPLACEABLE
A
B
?
C
D
Fodder beet. Mangold. Sugar beet. Spinach. Swiss chard. Table beet.
Cabbage. Coconut. Cotton. Kale. Lupins. Marrow-stem kale. Oats.
Potato. Rubber. Turnips.
Barley. Flax. Grass. Millet. Rape-seed. Wheat.
Buckwheat. Maize. Rye. Soya bean. Swede.

Fig. 1. Diagrammatic representation of crop classification according to potassium-replacing power of sodium and independent sodium-effect on yield

OPINION on sodium has passed through various phases as knowledge about the element has grown. Sodium was originally considered to be an inert substance playing no part in plant nutrition, but it was later found to be a physiologically active nutrient element necessary for maximum yield in certain crops, for example, beet, and complementary to potassium in its action. The tobacco and barley plants illustrated in Figures 2 and 3 show the power of sodium to prevent potassium deficiency symptoms. In both cases, as the captions show, the healthy plants were dressed with sodium, while the unhealthy ones were not.

By 1950 it had been found that there are certain functions in which sodium stands alone and is independent of potassium and that sodium deficiency symptoms can be detected. In the accompanying diagram a number of crop plants are classified according to their relative needs of potassium and sodium.* Those in group A, which all belong to the beet family, have a high capacity to absorb sodium; sodium can substitute for a considerable part of their potassium requirement, and they grow better in the presence of sodium even when there is ample potassium supply. Although there can be little doubt about the sodium-loving character of the crops in groups B, C and D, their classification is still somewhat arbitrary.

The essentiality of sodium was first discovered in 1955, when the American workers, Allen and Arnon, found the element to be essential to the blue-green alga, *Anabaena cylindrica*. Two years later Brownell and Wood, of the University of Adelaide, found that sodium is an essential element for the higher plant, *Atriplex vesicaria*, a member of the beet family.

Sodium has long been known to be an important nutrient for sugar-beet, fodder beet and table beet and the discovery that it is an essential element for another member of the family lends weight to the view that it should always be included in the fertiliser dressing of these crops.

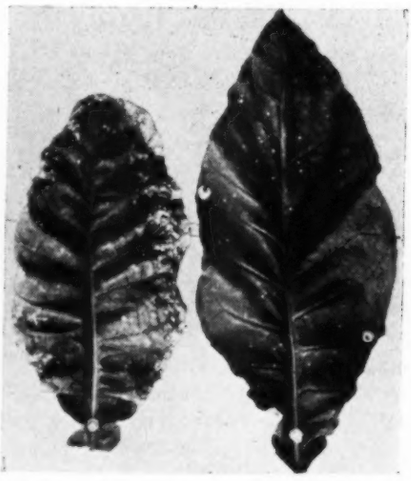


Fig. 2. Tobacco leaves from pot trial with humic sandy soil without potash dressing

Left: *Symptoms of potash deficiency on plant dressed with nitrate of lime*

Right: *Normal leaf from plant dressed with Chilean nitrate of soda*

Fig. 3. Barley plants from a field trial in Holland, grown without potash fertiliser

Left: *Plant, showing severe potash deficiency, was dressed with nitrate of lime*

Right: *Plant, showing no sign of potash deficiency, was dressed with Chilean nitrate of soda*

* Lehr, J. J.: 'Sodium as a Plant Nutrient', *J. Sci. Food Agric.*, 4 October, 1953.

Technical News

Articles in the September issues of some of the other journals of the Leonard Hill Technical Group include the following:

Chemical & Process Engineering. – 'Atomic Energy in Australia' by Prof. Baxter.

Dairy Engineering. – 'Profile of an Australian Co-operative Dairy'.

Food Manufacture. – 'Assessment of the Strawberry Crop at the British Food Manufacturing Industries Research Association'.

New Publications

Plant Growth Substances

By L. J. Audus. Pp. 554, illus. Leonard Hill (Books) Ltd., London. 1959. Price 65*s*.

It has long been known that many of the vital processes in plants are initiated and regulated by hormones. This happens in the animal body, with the difference that plants, unlike animals, have no central directing endocrine system. One of the triumphs of modern biochemistry has been the isolation of some of these substances and elucidation of their constitution; a still greater triumph has been the synthesis and manufacture of large numbers of organic compounds also capable of regulating plant growth, usually with some characteristics of their own. The natural hormones are ring compounds, many of the synthetic substances are not: they have a much wider range of action than the natural materials.

An enormous amount of research has been done on these various substances and the volume of literature is colossal. Professor Audus has therefore rendered a valuable service in producing this excellent treatise, in which he has reduced masses of detail to order and set out the subject so clearly that chemists will readily follow the botanical sections, and botanists should have no difficulty with the chemistry. This dual understanding is all the more necessary because the natural hormones occur in such small quantities that chemical methods fail to detect them and biological methods are necessary.

Most of the work has been done with auxins, the growth-promoting group of hormones, the type member of which is β indolyl acetic acid, and these occupy the larger part of the book. The group is complex: some members are free and diffusible (these have been most fully studied); others are bound and non-diffusible. Their action also is complex: beyond a certain concentration they cease to promote growth and may inhibit it, even causing death. The plant also produces inhibitors which at the appropriate stages bring the action of the auxins to a standstill, and it also produces anti-auxins.

The possession of the means to control plant growth naturally encourages their use in practice: this side of the subject is ably dealt with. The earlier hopes that auxins would increase crop yields were disappointing. Gibberellins increase the length of the cells and the height of the plant; they will transform dwarfs into climbers, also they increase the water content, but not the total dry weight.

In other directions, however, control agents have proved of great value in practice and a new branch of chemical industry has been developed to supply them. They are used by horticulturists for stimulating the rooting of cuttings of stems, roots, leaves, leaf buds etc.; for healing wounds by callus formation; for promoting graft unions; setting of fruits, especially in tomatoes; for producing parthenocarpic fruit; also for preventing the abscission that causes fruits to fall prematurely. They are also used for the converse processes: the prevention of sprouting of potatoes and the promotion of defoliation where, as for cotton and hops, the fruits are collected by machine. By far their most extensive use at present is as selective weedkillers. The total quantities so used are unknown, manufacturers being reluctant to divulge the figures, but they are very large.

A gratifying feature of the book is the recognition of the excellent work done at some of the British institutions, notably at Wye College, Long Ashton, Oxford, East Malling and Jealott's Hill, to discover what these substances do, and how they do it. The valuable work of the Dutch investigators and the Boyce Thompson Institute receives full justice, as does that of the many other organisations that have contributed to the development of this new and very promising subject. Professor Audus is to be congratulated on having assembled so much useful material and discussed it so lucidly that his book is indispensable to all interested in the subject.

E. JOHN RUSSELL

Technical Books

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Rice in India

Compiled by R. L. M. Ghose, M. B. Ghalge and V. Subrahmanyan. Edited by M. G. Kamath. Pp. 507. Illustrated and maps. New Delhi: Indian Council of Agricultural Research. 1956. Price Rs. 21.00.

This summary of research work in India is a most welcome addition to the literature on rice. The eminent compilers have succeeded in assembling many important results from the vast collection of articles published, mainly in India, over the past 60 years, some of which are not easily accessible to the general reader.

The book is divided into three parts, the first, on agriculture, being presented in three sections – general, research and extension, with a number of appendices. The remaining two sections are on marketing and technology respectively.

The necessity of improving the very low rice yields in India have been recognised for many years and there are now 75 research stations concerned with these investigations. Experimental results, it is claimed, show that yields can be appreciably increased by timely preparation of land, use of improved varieties, application of manures and fertilisers and adequate after-care of the crop. According to the compilers, it only remains to communicate the research results to the millions of rice farmers and induce them to adopt the improved practices. This is, perhaps, an undue simplification of the problem, since the main cause of low yields in India, as stated in another part of the book, is the dependence of the crop on vagaries of the monsoon, for only 25% of the area is under protective irrigation.

While this first attempt to summarise the work done in India is valuable, one doubts whether full justice is accorded to the very numerous scientists who have contributed to the study of rice in India;

the value of future editions will therefore be greatly enhanced by the inclusion of a comprehensive bibliography of Indian literature on rice.

The absence of a general index is the most serious omission from the present volume. The book also shows evidences of hurried preparation. Information on pests and diseases, for instance, is duplicated at some length in two sections, two research stations are omitted and bibliographical references in Part 1 are brief, unnumbered and cannot therefore always be identified in the bibliography. However, the book will be widely appreciated and such defects as are now evident will doubtless be corrected in the next edition.

D. H. GRIST

Manual of Plant Protection in Cotton

Plant Protection Department, Bayer, Leverkusen. 1959. Pp. 60, 20 illustrations in colour. On application

The importance of the world cotton industry can be appreciated from the fact that in 1955 the total area under this crop was more than 75 million acres. A closer study of the statistics, however, reveals that this industry has in the past been subjected to considerable annual fluctuations in yield, though in recent years production has continued to increase steadily. This can be attributed to a large number of factors, but one of the most important is the very great progress which has been made in crop protection.

The profitability of cotton cultivation is dependent to a very large extent on whether protective measures are carried out thoroughly and efficiently, because the cotton crop, more than most, is attacked by a large number of different pests. The boll, in particular, provides valuable food for the pests and, in addition, protects them against adverse weather, attacks by predators, and also against the control measures taken by man. The luxuriant foliage and the glands on the leaves also attract destructive insects. The large number of pests attacking this crop and the rapid advance in protective measures makes it necessary to provide the grower with up-to-date information and that is the purpose of this remarkably well-illustrated and instructive manual.

Gutta-Percha

Guttonosy, by A. D. Bukshtynov. In Russian. Pp. 197. Goslesbumizdat, Moscow and Leningrad. 1957. Price 7 roubles 70 kopeks.

'Plants Yielding Gutta-Percha' is a book devoted to the species of gutta-yielding *Euonymus* found in the U.S.S.R., and this may come as a surprise to those who think that natural rubber is a monopoly of the tropics.

Plantation growing of *Euonymus* species was started in the U.S.S.R. in the early 1930s, and already a formidable mass of experience has been built up. Of the 281 references, about 250 are Russian.

The U.S.S.R. now boasts 16 naturally occurring species of *Euonymus*, all shrubs or small trees, apart from several species introduced from China, Korea, Japan and the U.S.A. Descriptions of the principal species, *E. verrucosa*, *E. europaea*, *E. latifolia*, *E. maackii* and *E. japonica*, and data on the gutta yields of their root and stem bark are given. The exploitation of wild *Euonymus* and methods of assisting natural regeneration are also outlined.

Particularly valuable are the chapters on the production of planting stock in nurseries and on the layout and management of *Euonymus* plantations, *e.g. E. europaea* yields 500 kg. of gutta per ha. on maturity in southern Russia. Comparative trials indicate that *E. europaea* is the best yielding species to plant in the west of the Soviet Union and *E. maackii* in the east. A large-scale planting drive was launched some time ago.

Further chapters are devoted to selection and breeding and to pests and diseases, while the final chapter deals briefly with another Russian gutta-yielding shrub, *Eucommia ulmoides*.

The book is rather better produced than most Russian agricultural works and the subjects of the photographs, though not clear, are at least discernible. Furthermore, though he draws on a multitude of sources and collates widely scattered material, the author has avoided the faults of so many Russian writers, namely, long-windedness and repetition, and he has provided a concise and factual account of an interesting subject.

W. LINNARD

Annual Reports

National Vegetable Research Station. Ninth Annual Report, 1959. Obtainable from the Secretary, N.V.R.S., Wellesbourne, Warwick. Price not stated.

Report of the School of Agriculture, University of Nottingham, 1958. Obtainable from the University of Nottingham, Sutton Bonington, Loughborough, Leicestershire. Price not stated.

East Africa High Commission. Annual Report for 1958. Obtainable from the Information Officer, P.O. Box 30005, Nairobi, Kenya. Price not stated.

European and Mediterranean Plant Protection Organisation. Annual Report for 1958–59. Paris. Price not stated.

Empire Cotton Growing Corporation. Annual Report for 1959. Obtainable from 12 Chantrey House, Eccleston Street, London, S.W.1. Price not stated.

Imperial College of Tropical Agriculture. Report of the Governing Body and the Principal's Report for 1957–58. Obtainable from the London Office, 40 Norfolk Street, London, W.C.2. Price not stated.

East Malling Research Station. Annual Report for 1958. Obtainable from East Malling Research Station, nr. Maidstone, Kent. Price 17*s.* 6*d.* or $2.50.

Mauritius Sugar Industry Research Institute. Annual Report for 1958. Obtainable from the Director of the Institute, Réduit, Mauritius. Price not stated.

Rothamsted Experimental Station. Report for 1958. Obtainable from the Librarian, Rothamsted Experimental Station, Harpenden, Herts. Price 10*s.*

National Institute of Agricultural Botany, Vol. VIII, No. 2, 1958. Obtainable from the Institute Huntingdon Road, Cambridge. Price 10*s.*

International Institute for Land Reclamation. Annual Report for 1958. Obtainable from the Institute, P.O. Box 45, Wageningen, The Netherlands. Price not stated.

The Grassland Research Institute, Experiments in Progress. Annual Report for 1957–58. Obtainable from the Secretary, Grassland Research Institute, Hurley, nr. Maidenhead, Berkshire. Price 7*s.* 6*d.*

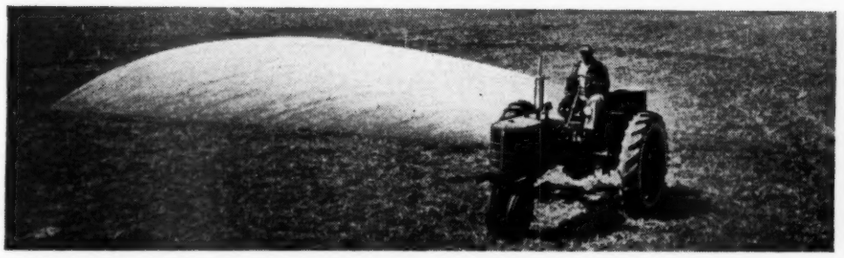
Seychelles Annual Report for 1958. Obtainable from the Government Press, Mahe, Seychelles.

Machinery and Equipment

Bush Clearing

A complete bush-clearing unit, consisting of a pusher bar fore-mounted on the hydraulically-controlled 'A' frame of a BTD6 crawler tractor and a 3-gang Mk. IXA Holt bush breaker, is now in successful operation in Kenya, Uganda and the Union of South Africa. This was produced by the *Holt Weed Breaker Co.* in collaboration with the *International Harvester* organisation.

The pusher bar, which was made locally of 85-lb. railway line, not only gives protection to the tractor and its driver, but also serves to lay the vegetation in the path of the breaker, the blades of which shear the stems and cut the roots, so preventing much of the regrowth which occurs with some other methods of bush control. The hydraulic control of the pusher bar allows it to be raised or lowered, so that it can be used at varying levels, and this gives a marked advantage over the rigidly fixed pusher bar for differing types of bush.



The ' DirectoJet ' (above) *spraying on one side only, down-wind, and* (below) *operating normally in still air conditions*

Controlled Broadcast Spraying

The wide swath of spray needed for the rapid coverage of vast areas of prairie, steppe, savanna, campagna, veld, heathland or pasture can be controlled and varied to suit wind and field conditions by using the ' Directo-Jet ' – a combination of spray nozzles and a controlling valve in one assembly – which is offered by the *Spraying Systems Co.*, of U.S.A.

The control handle is conveniently situated for the driver of the tractor, so that he does not have to leave his seat, and it provides three alternative positions, so that he may spray either to the left or to the right, or on both sides, or the supply can be cut off at once without after-surge or dripping.

Thus on windy days spraying can take place on the down-wind side, and, when spraying near boundaries or buildings, spraying can be stopped on that side. Normally, however, the unit is set to deliver a broad swath covering both sides. The unit is designed for use on arable lands and pastures, and where absolute uniformity is not necessary it can also be used for the application of liquid fertilisers.

The ' Holt ' bush-clearing unit as fitted to the BTD6 crawler tractor working on bush in Cape Province, South Africa

Ceylon Jungles for Sugar Cultivation

International Harvester announced recently the receipt of a contract for nine International BTD-20 crawler tractors to work in Ceylon. These

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England

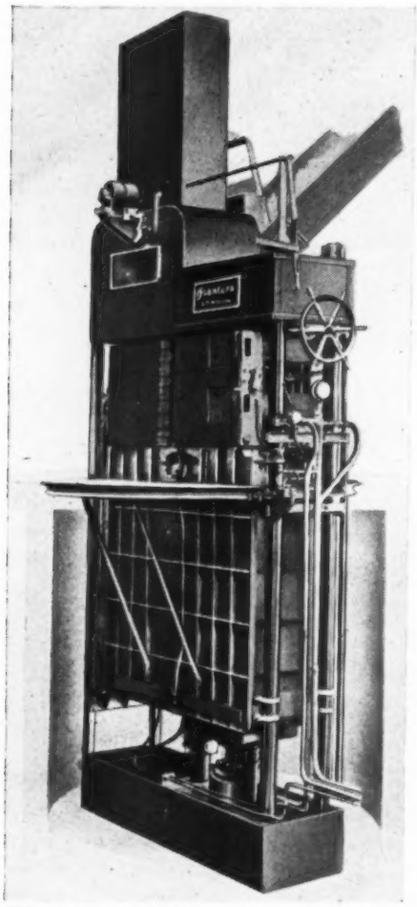
16½-ton units have 124-h.p. Rolls-Royce engines and are to be equipped with cable-operated bullgraders and power-control units.

These enormous machines will be operated under contract to the Gal Oya Development Board of Ceylon on a project to clear, pile and burn 6,000 acres of jungle and cross-harrow the cleared area in preparation for an expected sugar crop of 30,000 tons per annum. This is the first attempt on an appreciable scale to grow sugar in Ceylon.

Baling Presses

Planters Engineering Co. Ltd., who are specialists in the design and manufacture of baling presses, have now produced a heavy-duty baling press for cotton. This is the 'Vybart' hydraulic press, which is capable of producing 12 bales per hour, each weighing 400 lb. and of about 30 lb. per cu. ft. density.

The special feature in its design are two pressure boxes, which are arranged to move around a central column on roller bearings, so that while one box is being filled and partially compressed the other is receiving its final pressure prior to discharging the bale. The lint is introduced down a chute, at the bottom of which there is a paddle which kicks the material into the pressure box, where it is trampled down by a mechanical device and then held in a partially compressed condition before receiving its final compression in the second position.



The 'Vybart' baling press for cotton, showing the mechanism above and below floor level

To prevent any possibility of the cotton being contaminated by oil, special seals are fitted to both the main ram cylinder and the door lock, and the press is also adequately guarded and fitted with devices for the protection of the operator.

Silage Temperatures

If silage is properly made, it is richer in protein and more palatable, but it is necessary to use a silage thermometer if these qualities are to be regularly obtained.

Benedict (Agricultural) Ltd. offer a long-stem bimetallic thermometer of robust construction for taking the temperature of silage, hay, grain, compost, potato clamps and mushroom beds. The pointed stem, which is 14 in. long, is inserted into the material and the temperature is read on a dial with the scale protected by an untarnishable plastic material. Both the stem and the housing are chromium plated, so the instrument cannot rust or become discoloured and is not easily corroded by acids or alkalis.

The new Massey-Ferguson potato harvester in action

Potato Lifting

At the World's First Agronomical Congress, held in Rome last month, it was stated that a mechanical harvester, satisfactory in all respects, was badly needed by the farmer. It was said that even the best machine at present available will damage 30% of this very vulnerable crop. We have since been told that, on average, the damage is about 50%, and with some machines as high as 75%. Even forking can damage, say, one potato in five*.

By pure coincidence *Massey-Ferguson Ltd.* have just announced a new potato harvesting unit, which is the product of 10 years of research at the National Institute of Agricultural Engineering and has now been elaborated and perfected by the company. The new implement will be in full production in time for the 1960 harvest.

It is a trailed unit, which is driven by the p.t.-o. of a standard tractor, and it can be levelled or tilted by means of two hydraulic rams, one at the axle of each wheel. These are independently operated, so that the depth of digging can be controlled or the level can be corrected when working on undulating ground, or the whole unit can be lifted clear of the ground for road travel.

The machine will deal with rows from 26 in. to 30 in. in width. A 30-in. dia. disk digger will gently lift each plant in the row and deposit the soil

* Damage may be invisible *or* visible, slight or serious. On trials an iodine-blue test is used to show the invisible damage.

Tractor fitted with a foreloader for removing the topsoil and 'Bean' extension wheels for preventing wheelspin at work on the Oxford by-pass

and the plants on to a rotating plate. Loose soil falls through the grille of the rotor and the soil adhering to the plants is removed by contact with a 'fence' of spring tines. After this the potatoes encounter only rubber or rubber-covered parts.

The plants are turned off the rotor by means of a conical roller with a flexible rubber extension, which strips the potatoes from the haulm and directs them into a large elevating drum built like a cage. Here the haulms and tubers are separated by rubber fingers, and rubber tines comb between these fingers and remove the haulms.

The cleaned potatoes are discharged from the top of the separating drum on to a rotating sorting table made of rubber sheeting; here any defective potatoes are removed by hand and the good, clean potatoes pass on into a bag at the rear of the machine.

It is claimed that the machine can even operate satisfactorily on very wet land, and it will harvest between 1½ to 3 acres a day, according to conditions. Otherwise expressed, it can lift up to 30 tons of potatoes a day with a team of between four to six men, including the tractor driver.

The machine needs little maintenance or adjustment and there are only two points to be lubricated; three slip clutches are provided to protect vulnerable parts; its tubular frame is both light and robust; it is economical in power requirements and the operators are protected by non-slip platforms and guard rails.

Road Making

The value of wheel extensions for work in flooded paddy fields and on farms and plantations where rainfall is torrential and the tracks are rough and unmade has been repeatedly proved. Not so well known is their value in road-making. Recently work on a new arterial road in England was brought

The Birfield driving shaft, as fitted with conical sleeve guards, is indicated by the two arrows

to a standstill when tractors removing topsoil were bogged down in the mud. After 'Bean' wheel extensions had been fitted the work was resumed. The manufacturers are *Thomas Green & Son Ltd.*

Agricultural Implement Drives

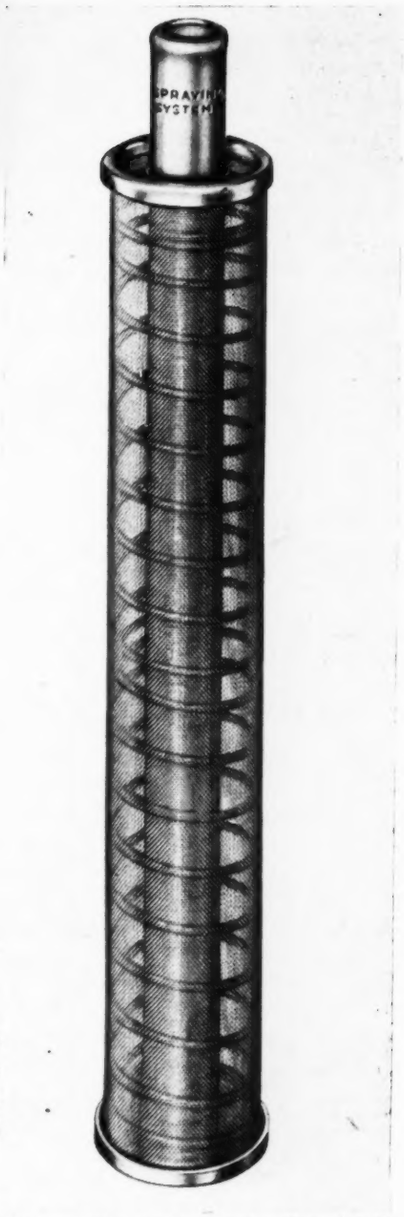
Important developments of special interest to agricultural engineers, contractors and farmers have been produced on behalf of *Hardy Spicer Ltd.* by *Birfield Engineering Ltd.* in connection with the transmission of power from tractor to implement.

For the shaft a special type of fluted tube has been developed. This is produced in sizes so that any one tube will fit closely inside the next largest size to give a telescopic assembly of shafting. As the flutes in the shafting are slightly offset, the joints and shaft sections can be assembled only in one way, so that the joints must always be in line. The section of the flutes is such that there is a relatively large area of radial contact which enables the tubing to transmit high torques. Another interesting feature is that the use of welding or brazing in the construction of the shaft assemblies has been eliminated.

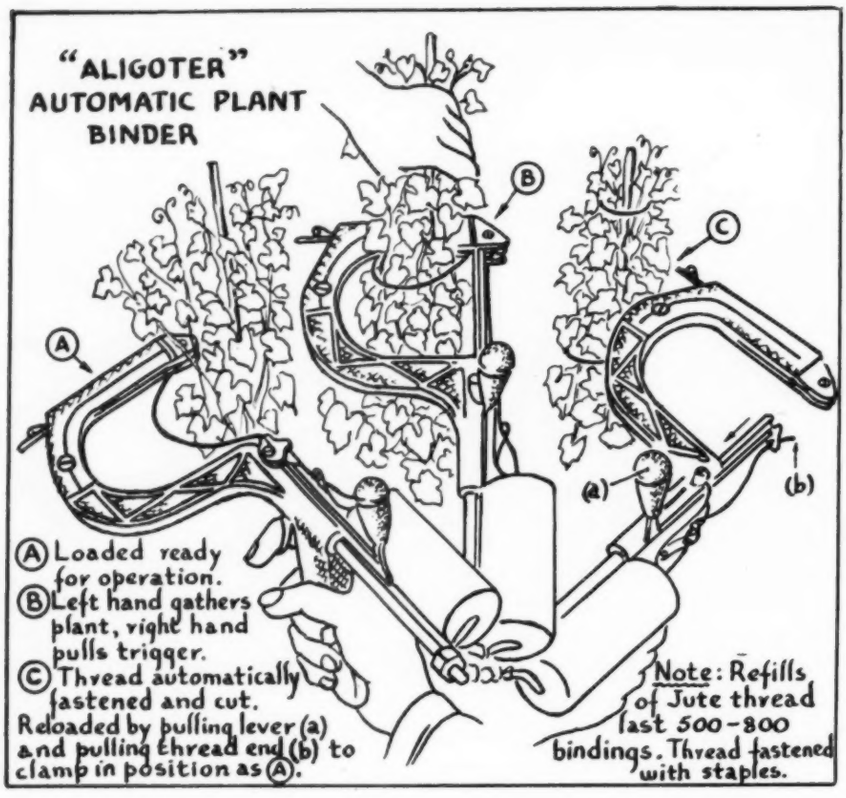
A simple form of guarding has been developed for use with the new shafts. A telescopic conical-ended sleeve is supported on ball bearings at both ends. Normally the guard will revolve with the shaft, but on contact with any outside interference it will stop, allowing the shaft to revolve freely inside it.

Large Surface Strainer

The new 8060 suction strainer recently introduced by the *Spraying Systems Co.*, of U.S.A., has an unusually large screen area and is designed particularly for high-volume spraying and to reduce the possibility of clogging and pressure loss to a minimum.



The new 8060 suction strainer introduced by Spraying Systems Co., of U.S.A.


"ALIGOTER"
AUTOMATIC PLANT
BINDER
A
B
C
(a)
(b)
(A) Loaded ready for operation.
(B) Left hand gathers plant, right hand pulls trigger.
(C) Thread automatically fastened and cut.
Reloaded by pulling lever (a) and pulling thread end (b) to clamp in position as (A).
Note: Refills of Jute thread last 500–800 bindings. Thread fastened with staples.

It is cylindrical in shape and can be attached to a suction hose for immersion in a tank or drum through the standard drum bunghole. Liquid can be withdrawn to within ½ to 1 in. of the bottom with the strainer either in the vertical or inclined position.

The strainer may be taken to pieces for cleaning by turning a knurled screw without any tools being needed. The body is made of aluminium, with monel metal screens in 50 or 100 mesh.

A Silent Silorator

The latest ' Dandy ' *Silorator* gives a 4-ft. 4-in. cut of lacerated grass, beet tops or silage and collects up to 12 tons per hour. It can be run from any medium-powered tractor and trailing offset will ensure a dirt-free pick-up. Its special features are (1) its simplified drive for the cutter heads and lacerator, (2) automatic knee action control for height, (3) independent height adjustment for the wheels and (4) self-aligning delivery chute, with side delivery optional.

The laceration produced with this machine makes it possible to produce silage of high dry matter content – 25% to 30% – without resorting to wilting, which requires two extra operations, with the possibility of undesirable secondary fermentation. Dirt is also a hindrance to the production of good silage and that is why the cutting mechanism is designed to ensure a dirt-free pick-up.

Irrigation Indicator

The *Wright Rain* indicator is a device which has been developed through research done at the National Vegetable Research Station. It shows how much water the soil needs to bring it back to field capacity.

It is a device which simulates the loss of water from the soil by transpiration from the leaves of plants. It measures the loss of water from a porous pad, which is kept constantly fed with water from a container which has a sight glass so graduated that when evaporation equivalent to 1 in. has occurred, the water level falls 1 in.

The evaporation from the pad simulates the loss of moisture from a green crop which completely covers the ground; when the green crop only partially covers the ground an adjustment ring can be fitted over the pad to reduce its effective area.

The indicator thus shows visually the depletion of soil moisture by a growing crop and indicates the need for moisture, but, of course, this information alone cannot tell one when to irrigate and exactly how much water to apply. This will depend on the nature of the crop – whether deep or shallow rooting – and the moisture-holding capacity of the soil, *e.g.* sand or clay. The decision when to irrigate must be influenced by the amount of moisture in the root zone at that time and whether this is likely to reach a critical level if moisture is lost at the rate indicated on the gauge. It is not always necessary or desirable to bring the soil back to field capacity with each irrigation and 80% is a good practical figure on which to operate.

Supporting Plants

An automatic plant binder, the ' Aligoter ', which ties, fastens and cuts twine in a single operation, is likely to find innumerable applications in planting, farming, commercial growing of fruit and vegetables, botanical gardens and plant research stations. It is a simple hand implement, weighing only 1 lb., which allows bindings from 4 in. to 12 in. in circumference. It does not bind too tightly and is easy to undo; a specially impregnated jute thread is used, having a tested resistance of 16 lb., and a roll, sufficient for 500 to 800 bindings, is carried in a cylindrical container. The tie is effected by means of a simple stapler, which forms part of the device.

This useful tool is recommended by the makers for securing vines, string beans, tomatoes, hops, roses, gladioli and young crop plants needing pole support. The stem of young rubber trees is very brittle, and in areas subject to ' sumatras ' or whirlwinds it is necessary to secure the plants to a support. This machine will, it is claimed, save time and labour and will pay for itself in a very short time.

Driver Protection

There are ' Stadri ' cabs for all makes of tractors. They give wide visibility, ample elbow room and head room and adequate ventilation through the sliding side windows and rolled-up backcloth; the roof and doors, too, can easily be removed, if so desired. The main advantages of the new glass-fibre roof are its sound-deadening properties. The cab is of welded steel construction – rigid and sturdy enough to withstand vibration and heavy work. ' Stadri ' cabs are made by *Bristol Metal Components Ltd.*

Agricultural Chemicals

Fertilisers and Food

Nitrogen is an essential component of all living tissues. Of the air we breathe, 80% is nitrogen, but neither animals nor plants can use elemental nitrogen to make the proteins from which these tissues are built. Proteins are made by plants, but plants can only obtain the nitrogen they need from certain substances present in the soil. The nitrogen-containing substances may be minerals, may be formed from lightning discharges and washed into the soil by rain, or they may be made by nitrifying bacteria, which convert atmospheric nitrogen into compounds capable of being assimilated by plants.

Methods of 'fixing' nitrogen from the air were unknown 60 years ago, and it then looked as if the rapidly increasing population of the world would starve for lack of protein-building nitrogen compounds. By the twenties ammonia synthesis for fertiliser manufacture was well established in the U.S.A. and Europe, including the U.K., and at times production even appeared to be in excess of demand. However, the nitrogen-hungry soil requires ever-increasing replacement quantities as food production rises to meet the increasing needs of the world's population.

The effect obtained by the application of 'Nitra-Shell' on a test strip of permanent pasture. The grass is taller, thicker and greener than the rest of the field

Liquid Ammonia

In view of the large potential market for nitrogenous fertilisers, *Shell Chemical Co. Ltd.* have erected a manufacturing unit at Thamesmouth, adjacent to their existing oil refinery at Shell Haven. The factors which led to the choice of site for the refinery were equally favourable for the fertiliser project.

Oil and chalk are the raw materials used to make ammonia, nitric acid and 'Nitra-Shell'. Ammonia is made by combining nitrogen and hydrogen together in the presence of a catalyst. The nitrogen is obtained by liquefying air and then separating the liquid nitrogen and liquid oxygen by fractional distillation. The hydrogen is obtained by burning oil in a restricted amount of oxygen in the presence of steam and adjusting the conditions so that the main products are hydrogen and carbon monoxide. More hydrogen is obtained by reacting steam with the carbon monoxide over a catalyst. The hydrogen is purified in a series of plants, mixed with the right amount of nitrogen, compressed and passed over another catalyst.

The ammonia so formed is kept under pressure, so that it remains liquid, and it is stored in a 1,000-ton sphere. Part of the ammonia is sold or used as such; the rest is burnt in air in the presence of a catalyst to give oxides of nitrogen, which are absorbed by water to give nitric acid. Some of the nitric acid is sold as such; the rest is neutralised with ammonia to give ammonium nitrate. This in turn is mixed with specially treated chalk to yield the dry granular fertiliser known as 'Nitra-Shell'.

Fertiliser application. Fisons 41 (10:10:18) is a complete mixture with a high potash content

Ammonium Nitrate

At the Stanford-le-Hope factory of *Fisons Ltd.* ammonium nitrate, containing 35% N, is made from synthetic ammonia and delivered by pipeline as an anhydrous liquid from the adjacent Shell Haven factory.

First, nitric acid is produced by the catalytic oxidation of part of the ammonia and the acid so obtained is neutralised with the remainder to give ammonium nitrate. The hot ammonium nitrate solution is distributed to fertiliser compounding factories in various parts of Britain by a fleet of road tankers and rail tank wagons provided with heating coils.

Hitherto sulphate of ammonia has been the source of nitrogen, but now a proportion of ammonium nitrate is to be incorporated in the fertilisers in the ' Fisons 40 ' range (see WORLD CROPS, 1958, **10**, 310). It has also made it possible to produce fertilisers of still higher nitrogen content – Fisons 42 (16–9–9) and Fisons 49 (14–6–20).

Ammonium nitrate will yield nitrogen in two different forms, quick-acting nitrate nitrogen and slow-acting ammonium nitrogen, from which the plant food is released more slowly and steadily.

Proud Record

' Ceresan ', the original dry mercurial seed dressing produced by *Bayer Agriculture Ltd.*, has played a major part in the 20th-century agricultural revolution, for in the last 30 years something like a thousand million bushels of grain have been harvested from 'Ceresan'-treated seed. This dressing gives protection against bunt and other seed-borne diseases of wheat, barley and oats.

Seed Dressing

The seed of wheat, barley, rye, oats, sugar-beet, cotton, groundnuts, jute, maize, rice and sorghum can be protected from fungal diseases with 'Agrosan GN' dry seed dressing, produced by *Plant Protection Ltd.*

This is an organo-mercurial product which adheres firmly to the seed and kills all seed-borne fungal spores that come in contact with it – without affecting the germination of the seed. It contains a special volatile constituent which will penetrate the glumes (chaff) of oats and kill all fungal spores underneath. It is claimed that this seed dressing will also reduce seedling blights caused by soil-borne organisms.

Potato Blight

In countries where the climate is erratic, a year of drought may well be followed by prolonged heavy rainfall in the following year. In the first year the size of the harvest is severely reduced through lack of rainfall when the tubers are forming, and in the second the crop may be severely reduced owing to the ravages of potato blight. Even in a dry year, like the present, conditions favourable for the spread of blight have occurred.

It is necessary to plan ahead, obtain a supply of fungicide in good time and give protection to the potatoes before the disease appears; it is costly to trust to luck and not be prepared.

Normally the first application is given just before the foliage of the plants of adjacent rows meet, or in areas where blight warnings are given, immediately after such warning is issued. Further sprays are then given at 14-day intervals, or at shorter intervals in a very wet season.

Circumstances will govern the choice of a fungicide – copper as dust or spray, MCO, zineb or, if the soil is deficient in manganese, maneb or manganese dithiocarbonate. The *Murphy Chemical Co. Ltd.* supply all these products and can advise on the most suitable material to use to obtain effective results.

Blister Blight Control

Blister blight is a disease which has been recorded on tea in Ceylon, India, Malaya, Indonesia and Japan, where it causes considerable damage and greatly reduces the output of the affected plantations. It is a leaf disease caused by the fungus *Exobasidium vexans* and it is propagated by air-borne spores.

In order to prevent the spread of the disease, the leaves of the plants must be protected by a thin film of fungicide applied to the upper surface of the leaves on which the spores settle. Copper compounds have generally been accepted as the best fungicides for this purpose, but the use of copper entails some risk of leaf injury.

The powerful fungicide ' Cobredon ', produced by *Jan de Poorter (Chemie) N.V.*, is claimed to possess a number of advantages over other copper formulations. In the first place, owing to its high fungicidal activity, smaller quantities can be used; secondly, the particles are extremely fine and thus it gives complete coverage and the leaves are covered with a very thin protective film; thirdly, it contains adhesive agents which ensure that the fungicide sticks to the plants and is not easily washed away by heavy rain.

The product mixes perfectly with water and can be applied by various kinds of spraying and fogging machines and also from the air; it is also compatible with many insecticides, so that a combined fungicidal and insecticidal action can be obtained in one operation.

Reader Service

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Reader Service,
WORLD CROPS,
Leonard Hill House,
Eden Street, London, N.W.1,
England

Shipping Bananas

Dr. Franco Beccari, of the Instituo Agronomico per L'Oltremare, in co-operation with the *Olin Mathieson Chemical Corporation*, has carried out tests of the antibiotic ' Mycostatin ' (nystatin) for the control of fungal growths on bananas during shipment from Somalia to Italy. These experiments were complicated by the fact that in the Red Sea the temperature on the deck of the ship ranges between 100° and 130°F during the passage.

The object was to delay the ripening of the bananas and at the same time prevent their decay and maintain their quality. The main purpose, therefore, was to show that it was possible to carry bananas on ships at this high temperature without cold storage.

Twenty boxes, each containing a bunch of bananas which had been dipped in a 0.04% solution of ' Mycostatin ' in water, were shipped, together with five bunches which had not been treated. These 25 boxes were placed together on the deck of the ship and covered with a waterproof awning.

On arrival in Italy the boxes of treated bananas were in perfect green condition except for one, the plastic cover of which had been broken. The remaining 19 were sold in the usual way. The five boxes of untreated bananas were absolutely unsaleable, the stems being broken and the fruit a yellow-brown colour.

The antibiotic used is a powerful fungicide which remains active during the first five to 10 days after application; thereafter it breaks down and becomes quite undetectable. This assures the consumer against any residual activity on the surface of the fruits, even though the fruits may not be washed before sale. The chemical agent is quite innocuous to animals at many times the concentration used.

World Crop Reports

INTERNATIONAL REPORTS

Tea in 1958

The increasing world output of tea continued during 1958, with production now estimated at 1,654 million lb.; this is 4.5% above 1957 production of 1,583 million lb. India and Ceylon alone accounted for 68% of total production.

India is the world's largest tea producer. Its 1958 crop reached a record 708.8 million lb. – 4% more than in the previous year. The crop would have been even larger but for the extremely dry weather during March, April and June and the shortage of foreign exchange, which restricted imports of ammonium sulphate.

Ceylon's output of 413.2 million lb. was an all-time record; frequent strikes, riots and shipping delays had little effect on production. A programme to rehabilitate and replant tea was inaugurated last year, as well as a subsidy rebate plan, designed to aid small producers of low-grade tea.

Indonesia's production has been somewhat static since the nationalisation of Dutch holdings, and there has also been a slight decline in quality.

Japan's output in 1958, although slightly up over 1957, was reduced by frequent unseasonable frosts from late March through mid-April, followed by extremely dry conditions in late June and early July.

Tea production in *Africa* continued to increase in 1958 and is estimated at 88.7 million lb. With sizeable areas already licensed for planting in East Africa, increasing yields from existing plantations, and a greater interest in tea growing by the Africans, further increases are expected. The three largest producers in Africa – Kenya, Nyasaland and Mozambique – all registered 1958 production increases.

Tea in 1959

World tea production in 1959 is forecast at 1,671 million lb. (excluding China and the U.S.S.R.). This would be about 1% greater than 1958 production and 24% above the 1950–54 average.

Relatively small increases are expected in India and Ceylon, while in other countries of this area production will probably remain close to current levels. African production in 1959 is expected to register another increase, as new plantings are beginning to bear and output from existing acreage is increasing. *Latin America* will probably produce about 10 million lb. of tea in 1959. Most of the tea in this area is grown in Argentina, where the industry is young and the potential is promising.

Hard Fibres

World production of sisal, abaca and henequen – the three principal hard fibres – was 1,749.8 million lb. in 1958, according to preliminary estimates. This was only 54.6 million lb. or 3% less than the revised estimates of 1,804.4 million lb. in 1957.

Hard fibres are cultivated mostly in tropical and semi-tropical regions and grown mainly for export as raw fibres. They are sold principally in Europe, the U.S.A. and Japan and are used to make cordage, bags and carpets.

Sisal has increased considerably both in quantity and its importance relative to the total production of hard fibres. In quantity it has increased from a 1935–39 annual average of 540 million lb. to a peak of about 1,229 million lb. in recent years. As a percentage of the total hard fibres, it has risen from 46% in 1935–39 to 53% in early post-war years, and to 70% last year.

Sisal production increased very little in 1958. About 1,229.2 million lb. were produced, compared with 1,228.5 million lb. in 1957, according to preliminary estimates. Increases in *East Africa* and *Angola* were almost entirely offset by sizeable decreases in *Brazil*, *Indonesia* and *Haiti*. Production in East Africa in 1958 set a new record.

The principal producing areas are in *Tanganyika* and Brazil, with Angola, *Kenya*, *Mozambique*, Haiti and Indonesia next in importance. These seven countries account for 93 % of the world's sisal. Africa is the most important continent, producing 756 million lb. in 1958. The *Western Hemisphere* produced 40,413 million lb. *Asian* production, principally in Indonesia, is decreasing, with no immediate prospect for a change in the trend.

Henequen production is increasing slowly, but the rapid post-war growth in sisal production has caused the relative position of henequen among hard fibres to decrease. It made up 21% of the total in 1935–39, 27% in 1946–50, but only 18% in 1958.

Henequen production increased in 1958 for the third successive year and is estimated at 308.6 million lb. *Mexico* produced 266.8 million lb., its largest harvest since 1948, and an increase of 7% over 1957.

Abaca production dropped considerably during the war and the subsequent upward trend during the next 10 years brought it back to only about three-quarters of the pre-war level of production. Abaca made up 33% of the total hard fibres in 1935–39, fell to 20% for the period 1946–50, then dropped to 12% in 1958. Prospects of increased production are not good.

Abaca production decreased to 212 million lb. in 1958, compared with 283.2 million lb. in 1957, or a drop of 25%. Most of the decrease was in the *Philippines*, which produces more than nine-tenths of all the abaca, but there was some decline in *Central America*. Severe drought, reduction in acreage, mosaic disease and unfavourable prices all contributed to the sharply reduced Philippine output.

Considerable change has been taking place in the Philippine industry, principally because of mosaic disease. The Southern Mindanao area now produces about half as much abaca as in 1954, while other areas are producing nearly a third more. For the first time in history, in 1958 there was less abaca production in Southern Mindanao than in other Philippine areas.

REGIONAL REPORTS

Rhodesia and Nyasaland

Figures published by the Central African Statistical Office show that the *cotton* crop, at 13,167,000 lb., was the largest since 1955. Of this total, 12,242,000 lb. was grown in Nyasaland, while the Southern Rhodesian European-grown crop at 859,000 lb. was the largest since 1954. The total acreage under *sugar* in Southern Rhodesia at the end of the 1957–58 season was 6,670, of which 2,810 acres

were productive and accounted for 64,000 tons of cane. The federal *potato* crop, produced mainly by European farmers in Southern Rhodesia, amounted to 360,000 bags, compared with 267,000 bags in 1957, but in spite of the increase the Federation still imported approximately 550,000 bags in 1958.

The 1957–58 season was an unfavourable one for *tea* and the Nyasaland crop was smaller. Southern Rhodesia's tea crop from the eastern districts amounted to 1,389,000 lb. in 1958. The federal *groundnut* crop was also smaller due to unfavourable weather conditions. These mostly affected the African grower in Southern Rhodesia, and only 78,000 bags were delivered to the Grain Marketing Board, compared with 245,000 bags from the previous year's crop. African growers in Northern Rhodesia produced only 42,000 bags, compared with 73,000, but Nyasaland production was relatively unaffected at 142,000 bags instead of 155,000.

Brazil

Brazil's 1958–59 *rice* crop has been sharply reduced by adverse weather conditions. The largest acreage on record was planted, but floods in the State of Rio Grande do Sul and drought in the central states greatly reduced yields.

Production in 1958–59 is now estimated at 8,200 million lb. of rough rice, compared with nearly 8,800 million lb. in 1957–58 and the 1956–57 record of 9,151 million lb. An estimated 6.4 million acres were planted, compared with 6.28 million acres the year before.

Before the mid-April floods Rio Grande do Sul was expected to produce a record crop of 900,000 metric tons of rough rice, but rains reduced the harvest to about 700,000 tons. Reports from the State of São Paulo predicted a 30% reduction by drought in the commercial rice crop of upland areas in the central states. These states – São Paulo, Minas Gerais, Goias and Mato Grosso – grow more than half of Brazil's rice crop.

Japan

Japan's 1959 *wheat* harvest is forecast at 48.6 million bushels, a slight increase over the 1958 crop of 47.1 million bushels, but this is less than average due to reduced acreage. Both the 1958 and 1959 wheat acreages are estimated at about 1.5 million acres, compared with the 1950–54 average of about 1.8 million.

Growing conditions have been favourable throughout the season and yields are estimated at 32.8 bushels per acre. Yields during 1950–54 averaged 30.2 bushels per acre, 8% less than the current yield.

Spain

Spain's 1958–59 *cotton* crop, estimated at 195,000 bales, was 18% above the 1957–58 level, despite an acreage reduction of 8% – from 433,000 acres in 1957–58 to 400,000 this season. The higher yield was attributed to generally favourable weather. About 90% of the 1958–59 crop was American upland-type cotton, about half of which was grown under irrigation. The remainder was Egyptian type, all irrigated.

Italy

Italy's 1958 *rice* harvest (September–October) is the largest since 1955. Estimated production, at 1,565 million lb. of rough rice, is substantially larger than the 1,316.1-million lb. crop of 1957, but is still below the average of 1,881.4 million lb. in 1950–54.

Rice acreage in 1958 increased 35,000 acres and favourable weather resulted in the highest per-acre yield since 1955.

France

The area now under *wheat* in France is estimated at 10.8 million acres. This is about 4% less than the large acreage of 1958.

The official figures of acreage under cereal crops on 1 May indicate a substantial shift from wheat to *barley*, a little over 4.6 million acres having gone into barley. As barley can be seeded up to mid-May with a reasonable assurance of producing a crop, the total barley acreage is expected to be even larger than was reported in May and will offset the cut in wheat acreage.

The condition of both the winter and the spring grain crops is above average. Though it is too early for firm indications of wheat production, average yields for recent years would mean a crop of 375 to 385 million bushels. This would be between the 1958 harvest of 350 million and the record out-turn of 407 million bushels in 1957.

England and Wales

The weather during June was warm and mainly sunny. There was little rainfall during the first three weeks, except from 5th to 8th, when occasional thunderstorms and outbreaks of rain occurred in many places. From 21st the weather became more changeable, with showers or outbreaks of rain in most areas.

Most crops of autumn-sown *wheat* looked well, but some crops sown on light land were adversely affected by the dry conditions. Autumn-sown *barley* and *oats* were generally good. Early-sown spring wheat, barley and oats were satisfactory, but later spring-sown crops suffered badly from the drought and in many areas were patchy and thin. Some mildew was reported. Mixed *corn* and *rye* were satisfactory on the whole, although lack of moisture retarded growth on light soils. *Beans for stockfeeding* made good progress, but severe blackfly attacks checked growth in some unsprayed areas. *Peas for stockfeeding* were promising.

Good progress was made with lifting the first early *potatoes*. The crops were healthy, but bulked slowly due to the dry weather and yields were expected to be slightly below average. Second early and maincrop potatoes also made good progress, but the growth of later plantings and of some crops on heavy land was retarded by the dry conditions.

Sugar-beet was generally satisfactory, but lack of rain caused patchiness; severe aphis attacks were widespread, where not controlled by spraying. Germination and growth of *mangolds* was uneven; many crops were patchy and fly attacks were reported from some areas. A considerable acreage of *kale* remained to be sown. Early sowings were generally fairly good, but later sown crops made only slow progress because of the lack of rain.

Conditions were very favourable for *haymaking* and rapid progress was made during June. Some crops were light and rather stemmy, but on the whole quality was good. Aftermaths made only slow growth.

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